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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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W91-00001 -- W91-01004

The Secretary of the Interior has deterimined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 1991.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

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Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

HYDROLOGY PAST AND PRESENT.
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
J. C. I. Dooge.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 1, p 5-26, 1988. 4 fig, 6 tab, 81 ref.

Descriptors: *Comprehensive planning, *Future planning, *History, *Hydrology, *Reviews, Water cycle.

Within the context of scientific disciplines, hydrology can be discussed either in relation to the other sciences dealing with water or in relation to its sister disciplines in geophysics and in the general context of the earth sciences. Until comparatively recently the approach to hydrology was essentially a pragmatic one. Development of continuity theory has guided the development of hydrology as a science. Deterministic approaches have dominated hydrology, although statistical mechanics and system theory are having a significant impact. Scientific hydrology is considered against the background of the classical development of scientific knowledge and applied hydrology is considered in the context of the many diverse factors relevant to providing water for health and for food throughout the world. Water cycles, health aspects of water supplies, and the use of water for irrigation focus attention on the social importance of hydrology. Future developments will include addressing hydrologic problems at the meso-scale, but progress will depend upon cooperation and communication among practitioners in the field. (Tappert-PTT)
W91-00066

MODELING INFILTRATION IN HYSTERETIC SOILS.
Kentucky Univ., Lexington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W91-00118

ONE-DIMENSIONAL INTERACTIVE SOIL-ATMOSPHERE MODEL FOR TESTING FORMULATIONS OF SURFACE HYDROLOGY.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
R. D. Koster, and P. S. Eagleson.
Journal of Climate JLCLEL, Vol. 3, No. 6, p 593-606, June 1990. 10 fig, 18 ref. National Aeronautics and Space Administration Grant NAG 5-743.

Descriptors: *Atmospheric circulation, *Climatology, *Hydrologic models, *Model studies, *Parametric hydrology, *Surface-groundwater relations, Boundary conditions, Climatic data, Precipitation, Radiation.

The longterm climate of an atmospheric general circulation model (GCM) is defined by the GCM's discretization of the fundamental conservation and state equations, its application of initial and boundary conditions, and its parameterizations of the various atmospheric and surface processes affecting the general circulation. A successful model climate matches the earth's observed climate and responds realistically to changes in boundary conditions. A model representing a soil-atmosphere column in a GCM was developed for offline testing of GCM soil hydrology parameterizations. Repeating three representative GCM sensitivity experiments with this one-dimensional model demonstrates that, to first order, the model reproduces a GCM's sensitivity to imposed changes in parameterization and therefore captures the essential physics of the GCM. The experiments also show that by allowing feedback between the soil and atmosphere, the model improves on offline tests that rely on prescribed precipitation, radiation, and other surface forcing. (Fish-PTT)
W91-00145

RADAR RAINFALL FORECASTING METHOD DESIGNED FOR HYDROLOGICAL PURPOSES.
Ecole Nationale des Ponts et Chaussees, Paris (France).
For primary bibliographic entry see Field 7B.
W91-00156

ESTIMATING GROUNDWATER RECHARGE USING A SURFACE WATERSHED MODEL: SENSITIVITY ANALYSES.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W91-00161

SPATIALLY CONTINUOUS DETERMINATION OF GROUNDWATER FLOW TO SURFACE WATER BODIES: APPLICATION TO THE CONNECTING CHANNELS BETWEEN LAKES HURON AND ERIE.
Wisconsin Univ.-Milwaukee. Dept. of Geosciences.
D. S. Cherkauer, and R. W. Taylor.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 349-369, May 1990. 8 fig, 2 tab, 24 ref. U.S. Environmental Protection Agency Great Lakes Research Program.

Descriptors: *Geophysical surveys, *Great Lakes, *Groundwater budget, *Groundwater movement, *Lake sediments, *Surface-groundwater relations, Conductance, Hydraulic properties, Hydrologic properties, Resistivity, Seepage, Seismic properties, Stream gages.

The International Joint Commission on the Great Lakes has sponsored an intensive, binational program to define the mass budgets, both water and chemical, of the channels connecting Lakes Huron and Erie. One of the more difficult components of the budgets to define is the quantity of water which enters or leaves a surface water body via the subsurface or groundwater route, usually because of a lack of information on the hydraulic properties of the materials beneath the surface water body. In order to quantify the total inflow of groundwater and its distribution in the channels, electrical resistivity and seismic data were collected along over 200 km of survey lines to allow definition of the thickness, general composition and hydraulic properties of the sediment column. The geophysics provided a measurement of electrical longitudinal conductance of the sediment column at 40-m intervals along the survey line. This parameter has been empirically related to the hydraulic leakage of the sediment column at discrete calibration points where seepage meters were installed. Groundwater discharges calculated using the geophysically-derived hydraulic properties compare very favorably with those calculated directly from the seepage measurements and others calculated independently from analysis of stream gaging records, thereby confirming the reliability of the hydrogeophysical approach. This approach offers the advantage of higher resolution of lateral variations in hydraulic properties and relatively low monetary and time expenditures when compared to a drilling program. However, calibration to direct hydraulic measurements is necessary. (Author's abstract)
W91-00163

RAINFALL-REAERATION EFFECTS.
Florida Inst. of Tech., Melbourne. Dept. of Chemical and Environmental Engineering.
T. V. Belanger, and E. A. Korzun.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 582-587, July/August 1990. 1 fig, 17 ref.

Descriptors: *Aeration, *Everglades, *Model studies, *Oxygenation, *Rainfall disposition, *Rainfall intensity, *Rainfall-reaeration relations, Florida, Instream aeration, Kinetic energy, Rainfall-runoff relationships, Wave action, Wind waves.

Many investigators have studied the reaeration process in streams, and numerous predictive equations are available. In the case of lentic systems, unlike flowing streams where turbulence generated by moving water is the major factor affecting reaeration, wind/wave action is the dominant force, and relatively little information is available regarding the resulting surface reaeration effects. The calculation of wind/wave effects on reaeration rates requires a knowledge of the mechanisms affecting the different wave formations and the transfer of kinetic energy from the atmosphere to the surface. While wind/wave interactions are currently being investigated, the effect of rainfall on reaeration needs to be quantified. Rainfall may be an important contributor of oxygen, particularly in undersaturated systems in geographic regions where frequent rainfall events occur. A study was undertaken to provide preliminary data on the rainfall intensity/reaeration relationship from small-scale field and lab pool studies. In oxygen budget and reaeration rate investigations, rainfall is usually neglected as a reaeration mechanism. Data show that the effect of rainfall on reaeration is quite significant, and imply that in geographic regions where frequent rainfall events occur, this effect can be very important and can provide a significant source of additional oxygen to an aquatic system. Calculations showing expected increases in reaeration rates for two areas in the Florida Everglades at various rainfall intensities support this conclusion. (Fish-PTT)
W91-00175

ENVIRONMENTAL ISOTOPE-AIDED STUDY ON RIVER WATER AND GROUNDWATER INTERACTION IN THE REGION OF SEOUL AND TAEGU.
Korea Advanced Energy Research Inst., Daeduk (Republic of Korea).
J. S. Ahn, I. S. Suh, J. S. Hahn, B. Payne, and P. Airey.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 371-384, 21 fig, 3 tab, 15 ref.

Descriptors: *Geohydrology, *Groundwater recharge, *Korea, *Seoul, *Surface-groundwater relations, *Taegu, *Tritium, Crystalline rocks, Han River Basin, Infiltration, Limestone, Paleohydrology, Percolation, Tracers.

Environmental isotope aided studies on river water and groundwater interaction in the Han River Basin, Korea, in areas composed of crystalline rocks and limestone, were conducted. The results indicate that the groundwater in the Seoul area is recharged by the Han River. In non-urban areas, the groundwater is recharged by infiltration and precipitation. The crystalline rock aquifers are recharged by downward percolation of shallow groundwater stored in overlying alluvium. Older groundwater has a low concentration of tritium ranging from 0-2 TU, and is observed at the lower Han River Basin near Bupyeong. This may indicate that the water sampled was recharged at a much earlier time than other groundwater that was sampled; possibly as early as the pre-thermonuclear period. The interaction study conducted in the karst area showed that there was no systematic difference in tritium levels between surface water and groundwater, and that the residence time of groundwater in limestone is probably not longer than a few months. The area recharged by water from the overlying alluvium into the sedimentary rock aquifer was restricted only along the Kumho River channel and its tributaries in a classic sedimentary rock area. Bedrock groundwater whose tritium level and stable isotope composition was less than 14 TU and -6.8 respectively and was observed in the central part of Taegu. (See also W91-00215) (Lantz-PTT)
W91-00257

NATIONAL WATER INFORMATION SYSTEM USER'S MANUAL VOLUME 2, CHAPTER 3. AUTOMATED DATA PROCESSING SYSTEM.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W91-00442

REMOTE SENSING AND LARGE-SCALE GLOBAL PROCESSES.
For primary bibliographic entry see Field 7B.
W91-00454

HYDROLOGICAL REMOTE SENSING RESEARCH WITH LARGE-SCALE APPLICATIONS IN WESTERN EUROPE.
Zurich Univ. (Switzerland). Remote Sensing Labs.
For primary bibliographic entry see Field 7B.
W91-00455

RELATIONSHIPS BETWEEN THE HYDROLOGIC BALANCE OF A SMALL WATERSHED AND REMOTELY SENSED SOIL MOISTURE.
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
E. T. Engman, G. Angus, and W. P. Kustas.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 75-84, 7 fig, 1 tab, 9 ref.

Descriptors: *Microwaves, *Model studies, *Rainfall-runoff relationships, *Remote sensing, *Soil water, Aircraft, Catchment areas, Drainage patterns, Evaporation, Evapotranspiration, Hydrologic budget, Streamflow.

The water balance of a small drainage basin has been simulated using a simple storage model. Aircraft microwave measurements of soil moisture were used to construct two dimensional maps of the spatial distribution of the soil moisture. Using data from flights on different dates also provided the temporal changes resulting from soil drainage and evapotranspiration. The remotely sensed soil moisture appears to be a valuable new data form for verifying model performance and identifying areas of the basin contributing to streamflow. (See also W91-00454) (Author's abstract)
W91-00463

RADAR DATA PROCESSING FOR HYDROLOGY IN THE CEVENNES REGION.
Laboratoire Central des Ponts et Chaussees, Bouguenais (France).
For primary bibliographic entry see Field 7B.
W91-00466

BASIS OF HYDRO-CLIMATIC TIME SERIES IN GREENLAND.
Greenland Technical Organization, Copenhagen (Denmark). Section of Hydro-Technical Investigation.
For primary bibliographic entry see Field 7C.
W91-00469

HYDROLOGICAL EFFECTS OF CATCHMENT CHARACTERISTICS AND LAND USE CHANGES DETERMINED BY SATELLITE IMAGERY AND GIS.
Ruhr Univ., Bochum (Germany, F.R.). Inst. for Hydrology, Water Resources and Environmental Engineering.
P. Neumann, and G. A. Schultz.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 169-176, 5 fig, 8 ref.

Descriptors: *Geographic information systems, *Hydrologic models, *Land use, *Model studies, *Rainfall-runoff relationships, *Remote sensing, *Satellite technology, Flood flow, Germany, Infiltration, Landsat images, Mathematical models, Seasonal variation, Surface runoff, Vegetation, Volme River.

A hydrological rainfall-runoff model uses satellite data in combination with data from a Geographic Information System for model parameter estimation. The model is based on the concept of 'source areas' contributing to surface runoff. Infiltration was computed on the basis of the Green and Ampt concept. All computations were carried out for grid cells, into which the catchment was subdivided, of Landsat TM pixel size (30 x 30 m). The model is being applied to the Volume River catchment in North West Germany. From GIS data the slope of each pixel within the catchment was computed and direction and velocity of flow to the pixel below determined. Landsat data were used for land use classification and estimation of vegetation indices. This information forms the (partial) basis for the estimation of infiltration and other hydrologically relevant parameters. Special emphasis of the research work, which is not yet completed, is placed on two aspects: the influence of the seasonally varying vegetation status on flood flows and the effect of land use changes over the years on runoff. Both effects were identified with the aid of Landsat data and introduced into the mathematical model. (See also W91-00454) (Author's abstract)
W91-00472

RAINFALL-RUNOFF RELATIONS DERIVED FROM THE PROBABILITY THEORY OF STORAGE.
IBM Research Lab., Yorktown Heights, NY.
For primary bibliographic entry see Field 2E.
W91-00592

ASSESSMENT OF A CONCEPTUAL RAINFALL-RUNOFF MODEL'S ABILITY TO REPRESENT THE DYNAMICS OF SMALL HYPOTHETICAL CATCHMENTS: 1. MODELS, MODEL PROPERTIES, AND EXPERIMENTAL DESIGN.
Washington Univ., Seattle. Dept. of Civil Engineering.
T. Y. Gan, and S. J. Burges.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1595-1604, July 1990. 4 fig, 42 ref. National Science Foundation Grant CES 8515250.

Descriptors: *Flow models, *Model studies, *Rainfall-runoff relationships, *Streamflow forecasting, Evapotranspiration, Mathematical models, Slopes, Soil moisture, Streamflow, Watershed management, Watersheds.

A set of tests is proposed to determine the reliability of soil moisture accounting rainfall-runoff models for prediction beyond the calibration experience and for extreme event forecasts under dry and wet antecedent conditions. The tests are developed for small (less than 0.5 square km) hypothetical hillslope catchments whose hydrologic response to rainfall and evapotranspiration fluxes is modeled with an accurate previously published physically based model (S-H) developed by Smith and Hebbert (1983). The tests are based on the assumption that the climatic and resulting S-H streamflow time series are error free. The conceptual model explored is a modified version of the Sacramento model (used by the U.S. National Weather Service) reprogrammed for inputs at various time increments as small as 1 min. A direct search optimization scheme is also included in this modified model (denoted SMA) to assist in model calibration. The set of tests is designed to illuminate differences in modeled evapotranspiration fluxes, streamflow time series, and the relative amounts of Hortonian and saturated overland flow and subsurface flow under a wide variety of climate and hillslope combinations. Differences in S-H and SMA model structures were predicted for subsurface moisture in dry periods, surface moisture in wet periods, evapotranspiration rates, percolation process, and mass balance determinations. The SMA model was found to oversimulate flows during dry periods and to accurately simulate flows when rain falls on a wet catchment. (See also W91-00605) (Author's abstract)
W91-00604

ASSESSMENT OF A CONCEPTUAL RAINFALL-RUNOFF MODEL'S ABILITY TO REPRESENT THE DYNAMICS OF SMALL HYPOTHETICAL CATCHMENTS: 2. HYDROLOGIC RESPONSES FOR NORMAL AND EXTREME RAINFALL.
Washington Univ., Seattle. Dept. of Civil Engineering.
T. Y. Gan, and S. J. Burges.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1605-1619, July 1990. 3 fig, 6 tab, 14 ref. National Science Foundation Grant CES 8515240.

Descriptors: *Flow models, *Model studies, *Rainfall-runoff relationships, *Streamflow forecasting, Climatic changes, Evapotranspiration, Flood forecasting, Hydrologic data, Mathematical models, Numerical analysis, Slopes, Soil water, Streamflow, Watershed management, Watersheds.

Five numerical experiments were conducted to test a conceptual rainfall-runoff model (the soil moisture accounting component, SMA, used by the U.S. National Weather Service), comprising combinations of three sets of input data (hourly precipitation and evapotranspiration data) and four hypothetical two-layered small catchments (areas less than or equal to 0.2 sq km, saturated hydraulic conductivity from 0.02 to 0.2 m/h, soil depth from 0.8 to 1.6 m, hillslope from 100 to 250 m, and slope from 0.04 to 0.10), representing a wide range of flow mechanisms. The calibrated SMA model could simulate flow volumes corresponding to broad-scale flow mechanisms but generally performed poorly during dry to wet catchment transitions. SMA was unreliable in forecasting extreme floods, especially under dry antecedent moisture conditions, and for catchments where calibration data comprised primarily base flow. For each case, the sum of the SMA conceptual storages differed from the maximum physical water storage capacity of the hypothetical small catchment. The calibrated SMA model parameters were climate dependent indicating that a calibrated SMA model should be used with caution when predicting hydrologic response to a changed climate. (See also W91-00604) (Author's abstract)
W91-00605

GAS EXCHANGE RATES FOR A FIRST-ORDER STREAM DETERMINED WITH DELIBERATE AND NATURAL TRACERS.
Lamont-Doherty Geological Observatory, Palisades, NY.
R. Wanninkhof, P. J. Mulholland, and J. W. Elwood.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1621-1630, July 1990. 5 fig, 3 tab, 30 ref. U.S. Department of Energy Contract DE-AL05-84OR 21400, NASA Contract NAGW 895.

Descriptors: *Aeration, *Air-water interfaces, *Environmental tracers, *Gas exchange, *Radioactive tracers, *Reaeration, *Streams, *Surface-groundwater relations, Groundwater movement, Oxygen, Radon, Stream discharge, Tennessee, Tritium, Walker Branch.

The rate of gas exchange between streams and the atmosphere is an important factor for water quality. Gas transfer velocities have been determined for a first-order stream, the West Fork of Walker Branch in eastern Tennessee, by performing a 3-hour release of the volatile tracer sulfur hexafluoride and the nonvolatile tracer tritiated water. The average gas transfer velocity for the 292-m reach was 29 cm/h which corresponds to a reaeration coefficient for oxygen at 25 C of 134/day. Groundwater inflow along the stream was corrected for by measuring the downstream dilution of the tritiated water spike. Downstream discharge increased from 0.5 L/s, 2 m downstream of the point of tracer release, to 19.3 L/s at a point 292 m downstream. As an alternative to using (radioactive) tritiated water, the possibility was investigated of using natural radon, Rn-222, as a groundwater tag and using the variation of sulfur hexafluoride and Rn-222 along the stream to determine gas exchange rates and groundwater inflow. The method yielded an average transfer velocity of 21 cm/h and underestimated the groundwater inflow by a factor of three. This large discrepancy is attributed to a doubling of stream discharge between the time the stream was sampled for radon and the tracer experiment and the limited number of radon samples. (Author's abstract)
W91-00606

COMPARATIVE DEVELOPMENT OF BOGS AND FENS IN CENTRAL SWEDEN: EVALU-

ATING THE ROLE OF CLIMATE CHANGE AND ECOSYSTEM DEVELOPMENT.
Harvard Univ., Petersham, MA. Harvard Forest.
For primary bibliographic entry see Field 2H.
W91-00641

POREWATER MIXING BY MICROORGANISMS, MONITORED BY A RADIOTRACER METHOD.
Stockholm Univ. (Sweden). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W91-00693

SEASONAL SOIL WATER DYNAMICS IN THE JARRAH FOREST, WESTERN AUSTRALIA. I: RESULTS FROM HILLSLOPE TRANSECT WITH COARSE-TEXTURED SOIL PROFILES.
Water Authority of Western Australia, Perth.
For primary bibliographic entry see Field 2G.
W91-00863

SEASONAL SOIL WATER DYNAMICS IN THE JARRAH FOREST, WESTERN AUSTRALIA. II: RESULTS FROM A SITE WITH FINE-TEXTURED SOIL PROFILES.
Water Authority of Western Australia, Perth.
For primary bibliographic entry see Field 2G.
W91-00864

NEW DIRECTIONS FOR SURFACE WATER MODELING.
For primary bibliographic entry see Field 7C.
W91-00961

REAL-TIME INTERCOMPARISON OF HYDROLOGICAL MODELS.
World Meteorological Organization, Geneva (Switzerland).
A. J. Askew.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 125-132. 4 tab, 5 ref.

Descriptors: *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *Streamflow, Comparison studies, Simulation.

From 1985 to 1988 the World Meteorological Organization undertook a project designed to compare the performance of hydrological models in a simulated real-time environment. A total of 14 models from 11 countries were run using four data sets. The results of the project include comparative descriptions of the models and their updating procedures, a comprehensive data set and the compilation of a series of comparative graphical and numerical verification criteria. (See also W91-00961) (Author's abstract)
W91-00974

MODELLING OF HYDROLOGICAL PROCESSES FOR A MOUNTAINOUS BASIN.
Tokyo Metropolitan Univ. (Japan). Dept. of Civil Engineering.
Y. Ando.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 143-147. 4 fig, 1 tab, 3 ref.

Descriptors: *Hydrologic models, *Model studies, *Mountain streams, *Rainfall-runoff relationships, *River basins, Groundwater storage, Hydrographs, Japan, Shiozawa Experimental Basin.

A new hydrological model without trial-and-error parameter calibration is proposed, based on a model developed for mountainous basins. It is simple, relatively clear in its physical meaning, and includes all hydrological components. The suitability of the model was examined by applying the model to the Shiozawa experimental basin in Japan. Computation of hydrographs and groundwater storages for 5 years showed good agreement with observed values. (See also W91-00961) (Sand-PTT)
W91-00976

REGIONALIZATION OF MODEL PARAMETERS FOR A LARGE WATERSHED.
Seoul National Univ. (Republic of Korea). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00979

ANALYTICAL RELATIONSHIPS BETWEEN RAINFALL AND RUNOFF FOR A PROBABILITY-DISTRIBUTED MODEL OF BASIN RESPONSE.
Instituto de Pesquisas Hidraulicas, Porto Alegre (Brazil).
For primary bibliographic entry see Field 2E.
W91-00980

MODELING SNOWFALL-TO-SNOWMELT DELAY.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2C.
W91-00982

CHARACTERISTICS OF STREAMFLOW DROUGHT.
Ohio Univ., Athens. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00994

DEVELOPMENT AND APPLICATION OF SIMPLE WATER BALANCE MODELS TO UNDERSTAND THE RELATIONSHIP BETWEEN CLIMATE AND WATER RESOURCES.
National Oceanic and Atmospheric Administration, Washington, DC.
J. C. Schaake, and L. Chunzhen.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 343-352. 6 fig, 5 ref.

Descriptors: *Climates, *Climatology, *Global warming, *Hydrologic budget, *Hydrologic models, *Model studies, *Precipitation, Evapotranspiration, Greenhouse effect, High flow, Low flow, Reservoir yield, Running waters, Runoff, Safe yield, Soil water, Temperature, Water resources.

An attempt was made to find a simple scientific basis, using water balance models, to calculate how the change in incoming water, outgoing evaporation and changed temperatures will change the water stored in soil and running in rivers. Simple water balance models, one linear and analytic and the other nonlinear and numerical, show that runoff is highly sensitive to the range of climatic change expected to be caused by increasing greenhouse gases in the atmosphere. In the southeastern quadrant of the U.S. arid places will be much more affected than humid, and low flow more affected than high. Water resources are more sensitive to precipitation change than to potential evapotranspiration. The safe yields, which are a measure of reliable water supply, were calculated as a percent of annual streamflow, by simulating reservoir operation with both the observed historical monthly streamflow and with estimated historical streamflow computed by the nonlinear model from historical climate data. Safe yields from the observed and estimated streamflow for 50 basins agreed within 20% error limits. (See also W91-00961) (Sand-PTT)
W91-00995

OBJECT-ORIENTED HYDROLOGICAL MODELLING (MODELISATION HYDROLOGIQUE ORIENTEE OBJECT).
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Genie Rural.
B. Adebnego, P. Meylan, and A. Musy.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 387-395. 8 fig, 5 ref. English summary.

Descriptors: *Decision making, *Expert systems, *Geographic information systems, *Model studies, *Water management, Hydrologic models, Simulation, Watersheds.

Hydrological studies for water management systems very often imply the use of hydrological modeling concepts for their design as well as for their management and their environmental assessment. Potentially, the various existing models can be applied, but they need some compromise between their flexibility and their possibility of utilization. Object oriented modeling proposes an alternative. It gives the possibility of treating each catchment component separately with a chosen existing model, in combination with the new tools for numerical geographical information systems. An expert system guides this choice and assists the user in his task, according to his objectives, and to the data and methods available. (See also W91-00961) (Author's abstract)
W91-00999

ENVIRONMENTAL GEOGRAPHIC INFORMATION SYSTEM IN FINLAND.
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 7C.
W91-01003

2B. Precipitation

FOURIER AND MOMENT METHODS APPLIED TO TWO-DIMENSIONAL RAINDROP IMAGES.
Alabama Univ. in Huntsville.
V. Chandrasekar, Y. Golestani, J. Turk, and V. N. Bringi.
Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 7, No. 2, p 199-205, April 1990. 12 fig, 1 tab, 21 ref, append.

Descriptors: *Cloud physics, *Data interpretation, *Fourier analysis, *Instrumentation, *Mathematical studies, *PMS probes, *Rain, Convective storms.

Two-dimensional PMS (Particle Measuring Systems, Inc.) probes are widely used in cloud physics research. PMS precipitation probes mounted with a horizontal optical axis have been previously used to study the shapes of hydrometeors such as raindrops and graupel. Fourier and moment descriptors have been applied to such images for the purposes of parameter estimation (axis ratio, canting angle) of raindrops, and for classifying raindrops in a raindrop/graupel mixture. Simulations have been used to evaluate these techniques. The results show that axis ratios of raindrops can be accurately estimated using both Fourier and moment methods. The canting angle of the raindrop image can be accurately estimated using the moment method. The moment method of image classification was applied to data collected from below the melting level in a convective storm during the MAYPOLE experiment held in 1983 near Boulder, Colorado. However, the fluctuations in raindrop fall speed (relative to airspeed) and axis ratio can produce a wide scatter in the image canting angle so as to mask any feature of the intrinsic canting angle, which is known from theoretical consideration to be very small. The application of Fourier and moment descriptors to simulated data to classify elliptical raindrops and conical graupel was compared to the results of a visual classification scheme performed on data from 2D-PMS probes. Among the two schemes, the Fourier descriptor-based technique performed approximately 14% better than the moment-based technique, with an 82% acceptance ratio for raindrops in a raindrop/graupel mixture. (Tappert-PTT)
W91-00055

MEASUREMENT OF RAINDROP SIZE DISTRIBUTIONS USING A SMALL DOPPLER RADAR.
Atmospheric Environment Service, Downsview (Ontario).
B. E. Sheppard.
Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 7, No. 2, p 255-268, April 1990. 19 fig, 19 ref.

Descriptors: *Cloud physics, *Data acquisition, *Radar, *Rain, *Rainfall, *Remote sensing, *Water properties, Data interpretation, Statistical methods, Wind.

Knowledge of raindrop size distributions is necessary to model the microphysics of precipitation, to establish empirical relationships between radar measurements and rainfall parameters, and to determine atmospheric attenuation of electromagnetic radiation. A small X-band bistatic Doppler radar originally developed for use in automated weather stations as a Precipitation Occurrence Sensor System (POSS) can also measure real time raindrop size distributions. In contrast to large-scale pulsed Doppler radars this system is continuous wave and the measurement volume is relatively small. The sampling requirements for a representative average power spectrum are estimated using a Poisson probability distribution. The effect of winds on the measurement results in a redistribution of the power in the Doppler frequency spectrum, generating an increase in the mode diameter of the normalized weighting functions. The POSS measures rates that are consistent with conventional gauges assuming a 6 dB transmission loss due to water on the radomes. Average drop size distributions measured in stratiform rain are typically negative exponential for diameters greater than 0.7 mm. One-minute averages in rain showers show the multimodal character of the distribution. (Tappert-PTT)
W91-00056

MODELLING LONG-TERM RAINFALL PATTERNS IN NORTH-EAST ENGLAND.
D. Wheeler.
Meteorological Magazine MTMGA5, Vol. 119, No. 1413, p 68-74, April 1990. 7 fig, 4 tab, 11 ref.

Descriptors: *Climatology, *England, *Meteorology, *Model studies, *Rainfall, *Rainfall distribution, Climatic data, Computer models, Geography, Regression analysis.

Rainfall is one of the most important climatological elements. Despite a traditional reliance on raingauge data it must not be forgotten that they provide only point sample data from a geographically continuous population. The underlying character of that population can only be established by statistical inferential methods that model and generalize its behavior, often in relation to other variables of which the three spatial dimensions of height and location (defined by Cartesian coordinates) are the most important. The utility of such models insofar as they are able to reproduce and, by inference, explain the geography of rainfall is examined. Mean annual and monthly rainfalls from 133 gauges in northeast England have been used to study the variation of rainfall with height and location in this area. The results clearly demonstrate that, in this case at least, order in rainfall regimes and distributions can be both recognized and quantified to the advantage of hydrologists and climatologists. Spatial (trend-surface) models of quadratic and cubic form are preferred to regression models using spot heights, but the most efficient methods combine all three dimensions: height, latitude and longitude. It has also been shown that monthly models might be preferred to annual models when detailed reconstruction interpretations are sought. (Mertz-PTT)
W91-00099

SPATIAL AND TEMPORAL VARIABILITY OF PRECIPITATION ACROSS KENTUCKY.
Louisville Univ., KY. Dept. of Geography.
D. A. Howarth.
Transactions of the Kentucky Academy of Science TKASAT, Vol. 51, No. 12, p 69-73, March 1990. 7 fig, 1 tab, 11 ref.

Descriptors: *Climatology, *Kentucky, *Meteorology, *Precipitation, *Precipitation mapping, *Weather data collections, Fluctuations, Geography, Seasonal variation, Spatial variation, Temporal distribution, Temporal variation.

Many areas in the U.S. have experienced abnormally dry conditions during the current decade. At the same time, temperatures have been above normal for much of the 1980s. This study makes use of divisional precipitation data for Kentucky to examine seasonal and annual precipitation during this century. Primary emphasis is directed toward ascertaining differences in precipitation regimes across the state in both the spatial and temporal dimensions. Precipitation records available from the National Climatic Data Center were used to analyze spatial and temporal variability in Kentucky's four climate divisions for the period 1895-1983. A statistically significant decrease in winter precipitation was noted for division 3 with similar, but not significant, trends noted in the other divisions for that season. These decreases are balanced by long-term increases in precipitation during the other three seasons. No statistically significantly trends in long-term variability were evident. A shift in the month of maximum precipitation from March to July occurred from west to east across Kentucky. Seasonal variability also decreased eastward across the state. (Mertz-PTT)
W91-00110

SPATIAL ORGANISATION OF DAILY RAINFALL IN WALES DURING AUTUMN-WINTER.
Saint David's Univ. Coll., Lampeter (Wales). Dept. of Geography.
G. Sumner, and M. Bonell.
Weather WTHRAL, Vol. 45, No. 5, p 174-183, May 1990. 7 fig, 2 tab, 14 ref.

Descriptors: *Climatology, *Meteorology, *Precipitation, *Precipitation forecasting, *Rainfall distribution, *Spatial distribution, *Wales, Geography, Weather data collections, Weather forecasting, Weather patterns.

Perched on the western extremity of southern Britain, and exposed to the prevailing rain-bearing winds from the North Atlantic Ocean, Wales' precipitation is, at all time-scales, often both copious and persistent. The spatial organization of precipitation amounts, however, is much influenced by the relatively high relief and altitude of a large part of the country and by resultant exposure to (or shelter from) rain-bearing winds. Over time-scales of a day or less, the interaction between near surface airflow at the time of precipitation and topography can induce notable spatial variations in precipitation amount and intensity. Historically, local administrative units within Wales have developed in response to topographic controls. These form convenient areal forecasting units currently used in media and telephone forecasts, since most members of the public related more easily to such political divisions. A pilot study of Welsh daily precipitation aimed at investigating the various methods of deriving daily precipitation areas attempted to derive daily precipitation affinity areas using data from 121 gauge sites for a sample data period between September and January from 1982/83 to 1986/87. Results showed that existing forecasting divisions may be too broad. Revision and subdivision of the presently used forecasting areas might be in order. The use of a simple visual grouping mechanism in conjunction with a simple statistical technique has afforded a subdivision of Wales into a number of daily precipitation affinity areas for the autumn/winter season. The form and location of the derived areas is such that the division between them may be explained in topographic terms, relating often to easily-defined catchment and administrative areas, in common current use for purposes other than precipitation forecasting. (Mertz-PTT)
W91-00115

EFFECT OF IRREGULARITIES IN T'IE DIAMETER CLASSIFICATION OF RAINDROPS BY THE JOSS-WALDVOGEL DISDROMETER.
Atmospheric Environment Service, Downsview (Ontario).
B. E. Sheppard.
Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 7, No. 1, p 180-183, February 1990. 4 fig, 12 ref.

Descriptors: *Disdrometers, *Instrumentation, *Joss-Waldvogel Disdrometer, *Measuring instruments, *Precipitation, *Rain, Cloud liquid water, Electromagnetics, Model studies, Rainfall.

Measurements of raindrop size are needed to model the microphysics of precipitation, to establish empirical relationships between radar measurements and rainfall parameters, and to determine atmospheric attenuation of electromagnetic radiation. The Joss-Waldvogel Disdrometer (JWD) is an electromechanical counter designed to measure raindrop size distributions for the purpose of calculating radar reflectivities. It has performed this function successfully for 20 years. Recently, JWD measurements have been used by cloud physicists to assess the predictions of models based on raindrop coalescence-breakup processes. The models show that the cloud-base drop size distribution (DSD) evolves with time and fall distance to an equilibrium distribution with secondary maxima. A number of researchers using the JWD have noted peaks in DSDs measured in a large range of rainfall rates. The JWD signal processing electronics sized the raindrops in 20 channels of diameter intervals. Laboratory calibration of the transfer function of the electronics (model RD-69) indicates that the boundaries of these channels differ from their specified diameter values. The effect of this discrepancy is demonstrated by applying the measured channel boundaries to a Marshall-Palmer distribution. The resultant DSD shows secondary maxima occurring in the channels with diameter boundaries 0.6-0.7, 1.0-1.2, and 1.8-2.1 mm. It is recommended that conclusions drawn from secondary maxima in DSDs measured by the JWD consider this artifact. (Author's abstract)
W91-00141

ONE-DIMENSIONAL INTERACTIVE SOIL-ATMOSPHERE MODEL FOR TESTING FORMULATIONS OF SURFACE HYDROLOGY.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2A.
W91-00145

EMPIRICAL DATA ON CONTEMPORARY GLOBAL CLIMATE CHANGES (TEMPERATURE AND PRECIPITATION).
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
K. Y. Vinnikov, P. Y. Groisman, and K. M. Lugina.
Journal of Climate JLCLEL, Vol. 3, No. 6, p 662-677, June 1990. 11 fig, 11 tab, 33 ref.

Descriptors: *Air temperature, *Climatic changes, *Climatic data, *Climatology, *Global warming, *Precipitation, Carbon dioxide, Model studies, USSR, Weather data collections.

Meteorological data have been recorded over the Northern Hemisphere and a part of the Southern Hemisphere over the last 100-150 years, and are sufficient to detect not only regional but also global changes in climate typical of the modern epoch. Principal among the climate elements most influencing the biosphere and man's activities are surface air temperature and precipitation. New analyses of global surface air temperature and annual precipitation over extratropical continents of the Northern Hemisphere differ from analogous earlier research both by initial database, which is more full and reliable for the USSR territory, and the spatial averaging methods considered to be most appropriate for the problem. Global warming occurred during the last century with a mean trend of 0.5 C per 100 years. For the same period the annual precipitation over the land in the 35-70 degrees North zone increased by 6%. The observed variations of precipitation coincide with the results of general circulation modeling of doubled

CO2 equilibrium climate change by sign but contradict by scale. Observed changes in precipitation for the USSR and United States territories considerably exceed those that could be explained by the indicated climate change modeling results. Measurement data on precipitation requires further analysis concerning their homogeneity; however, the real process of climate change in the current century strongly differs from the modeled one. (Fish-PTT)
W91-00146

RAINFALL INTERCEPTION IN THE TAI FOREST, IVORY COAST: APPLICATION OF TWO SIMULATION MODELS TO A HUMID TROPICAL SYSTEM.
Groningen Rijksuniversiteit (Netherlands). Dept. of Physical Geography.
R. W. A. Hutjes, A. Wierda, and A. W. L. Veen.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 259-275, May 1990. 5 fig, 3 tab, 40 ref.

Descriptors: *Forest hydrology, *Forest watersheds, *Humid climates, *Interception, *Ivory Coast, *Model studies, *Rain forests, *Simulation, *Throughfall, Africa, Effective precipitation, Error analysis, Evaporation rate, Meteorological data, Rain gages, Rainfall distribution, Tropical regions.

Forest greatly influences hydrology through runoff, erosion, evaporation, precipitation, and global climate. The special hydrological significance of forest is its high total evaporation. It has been shown that the large aerodynamic conductance of forest, causing a strong coupling between canopy and atmosphere, is the primary cause of this phenomenon. In recent years attempts have been made to apply modeling to the study of evaporation in the tropical rain forest. Field estimates of net precipitation in primary evergreen forest in Ivory Coast, West Africa, were compared with estimates given by two models: the Gash model, which assumes all rain on a single day to have fallen in one shower, and the Mulder model, which uses a more realistic, equalized rainfall distribution. Meteorological data were collected in a clearing of about two hectares. Throughfall, measured using a roving gage technique, was 90.8% of gross rainfall (1022 mm in five months). Both models simulated this figure well within the error range of the field estimates. Errors in the model predictions are thought to result from errors in the parameter estimates, and, for the Gash model, from the assumption that daily rainfall comes in one shower. It is suggested that a model combining the advantages of both might be suitable for routine application in the humid tropics. (Author's abstract)
W91-00158

ANALYSIS OF INSTANTANEOUS RAINFALL RATE DURING FLASH FLOODS IN BARCELONA.
Barcelona Univ. (Spain). Dept. of Atmospheric Physics, Astronomy and Astrophysics.
A. Redano, and J. Lorente.
Weather WTHRAL, Vol. 45, No. 6, p 215-222, June 1990. 7 fig, 6 ref.

Descriptors: *Barcelona, *Convective precipitation, *Flash floods, *Flood forecasting, *Rainfall rate, *Rainfall-runoff relationships, *Spain, *Weather data collections, Mediterranean Sea, Rain gages, Rainfall intensity, Storms.

Rainfall in the Mediterranean regions of the Iberian Peninsula is characterized by the predominance of convective precipitation. A method is needed to determine the damaging effects due to the instantaneous rainfall rate, based on the establishment of dense local scale and mesoscale rain gage networks. These dense networks of rain gages are therefore installed in zones which are very vulnerable to heavy precipitation such as urban areas, hydrographic basins, etc. From data obtained in this network, a number of storms have been studied. It was found that convective precipitation in the coastal Mediterranean fringe can occasionally be of a very heavy intensity. The statistical analysis of a 60-year rainfall rate data bank in Barcelona, Spain, gave storm durations (with rainfall > or = 60 mm/hr) of less than 2 hr in 88% of cases. The storms generally occur during autumn and summer in the early evening. Because of the strong spatial variation of rainfall rate, the data obtained with only one rain gage, and therefore the corresponding intensity-duration-frequency curves, are not sufficient to estimate the total rainfall in a zone. Statistical data, based on dense rain gage network measurements, seem indispensable. Normally the individual raincells are smaller than 10 km, so they belong to the local scale. In these cases, synoptic situations are almost irrelevant, since the influence of the Mediterranean Sea is the most influential factor of enhancement of precipitation in autumn, although in conjunction with other factors. Nowcasting, based on radar, satellite imagery and rain gage network data, is the best system for flood alert and prevention, because of its small spatial and temporal scale. (Fish-PTT)
W91-00189

CLIMATIC CHANGE IN SUNDERLAND.
Sunderland Polytechnic (England). Dept. of Geography.
D. A. Wheeler.
Weather WTHRAL, Vol. 45, No. 6, p 229-231, June 1990. 3 tab, 3 ref.

Descriptors: *Climatic changes, *Climatic data, *Climatology, *England, *Global warming, *Rainfall impact, *Weather patterns, Air temperature, Potential water supply, Rainfall, Water supply, Wind.

The weather of 1989 has sharpened both the public's and the scientist's concern about man-induced climatic change. Conditions were particularly unusual in Sunderland, in northeast England. Temperatures in 1989 were the warmest on record with a mean of 10.5 C. Despite the high mean conditions, no absolute maximum records were broken and the year was characterized by persistently high rather than extremely high temperatures. It was the sunniest year on record. Part of the character of 1989's weather can be accounted for by random variation. Nevertheless, such peculiar behavior should act as a warning signal. It is at this early stage difficult to predict the detailed regional patterns of rainfall change. However, the events of 1989 should draw attention to the apparent vulnerability of the northeast region to climatic variation. In particular, any increase in the frequency of westerlies may be critical. In this case western districts might expect higher rainfall but the increasingly sheltered eastern regions, especially those such as northeast England which are protected by the highest hills, should expect much drier conditions. Winds were unusually dry and concentrated in the southwest and westerly sectors in 1989. However, the winds to which the region is most exposed and which provide the majority of the rain, those from between north and southeast, were correspondingly less abundant. A geographical disequilibrium of water supply potential may be a more immediately serious threat to the British Isles than a slight warming. (Fish-PTT)
W91-00190

DYNAMIC MODEL FOR SHORT-SCALE RAINFALL DISAGGREGATION.
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
D. Koutsoyiannis, and T. Xanthopoulos.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 3, p 303-322, June 1990. 7 fig, 3 tab, 16 ref.

Descriptors: *Depth-area-duration analysis, *Rainfall simulation, *Statistical disaggregation, *Statistical models, *Stochastic hydrology, Probability distribution, Rainfall distribution, Rainfall intensity, Statistical analysis, Statistical significance.

A single site dynamic disaggregation model was developed. It is a generalized step-by-step approach to stochastic disaggregation problems. The low-level variables studied have Markovian structure and normal or gamma marginal distributions. Combined with a rainfall model, the disaggregation scheme serves as a rainfall generator, transforming monthly rainfall into events and hourly amounts. Application of the combined model with all parameters derived from historical records gives satisfactory results. Various statistics, as well as marginal distribution functions of the associated variables computed from synthetic samples derived by the model, exhibited agreement with the theoretical expectations; the relevant statistical tests of 5 percent or 10 percent significance levels were positive. (Fleishman-PTT)
W91-00409

EFFECTS OF THE DRY SEASON ON THE VEGETATION CANOPY OF SOME RIVER BASINS OF WEST AFRICA AS DEDUCED FROM NOAA-AVHRR DATA.
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 2I.
W91-00410

REMOTE SENSING AND LARGE-SCALE GLOBAL PROCESSES.
For primary bibliographic entry see Field 7B.
W91-00454

PHYSICAL CAUSES AND PREDICTABILITY OF VARIATIONS IN SEASONAL RAINFALL OVER SUB-SAHARAN AFRICA.
Meteorological Office, Bracknell (England).
C. K. Folland, J. A. Owen, and K. Maskell.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 87-95, 5 fig, 1 tab, 14 ref.

Descriptors: *Climatology, *Drought, *Meteorology, *Model studies, *North Africa, *Rainfall, *Sahel, *Water temperature, Tropical regions, Wind.

Possible causes of the decadal timescale decline in rainfall in sub-Saharan Africa observed since the 1950's have been much studied and several mechanisms have been suggested. A study which used an 11-level atmospheric general circulation model indicated that global scale sea surface temperature patterns may play a key role in modulating sub-Saharan rainfall. Using the model, the persistence of SST anomalies during the latter half of the rainfall season was sufficient to allow useful hindcasts of sub-Saharan rainfall for three months ahead in two wet and two very dry years. (See also W91-00454) (Author's abstract)
W91-00464

POTENTIAL APPLICATION OF SATELLITE DATA FOR RAINFALL ESTIMATION.
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 97-104, 2 fig, 2 tab, 19 ref.

Descriptors: *Florida, *Meteorology, *Rainfall, *Remote sensing, *Satellite technology, Estimating, GOES satellite, Infrared imagery, Rain gages, Rainfall distribution, Weather forecasting.

Geostationary Operational Environmental Satellite (GOES) visible and thermal infrared data, in conjunction with the Griffith-Woodley method, were used to estimate rainfall in Florida. Both the life history and streamline techniques of the Griffith-Woodley method were studied. The results showed that the satellite data were useful for estimating both the volume and areal distribution of rainfall, which are very difficult to assess using the conventional rain gage method. The rain gage rainfall (GR) was well correlated with satellite rainfall estimation (SR) for the life history technique, i.e., GR = -0.557 + 1.079 SR, in units of mm/day; whereas, for the streamline technique, GR = 2.007 + 1.525 SR. (See also W91-00454) (Author's abstract)
W91-00465

MONITORING OF WEATHER CONDITIONS ON MESOSCALE TO IMPROVE A PRECIPITATION WARNING SYSTEM FOR HYDROLOGIC PURPOSES.
Kozponti Elorejelzo Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 7B.
W91-00467

FREQUENCY DISTRIBUTIONS OF HEAVY RAINSTORMS IN ILLINOIS.
Illinois State Water Survey Div., Champaign.
F. H. Huff, and J. R. Angel.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-100215. Price codes: A03 in paper copy, A01 in microfiche. Report No. ISWS/CIR-172/89, 1989. 36p, 14 fig, 4 tab, 7 ref.

Descriptors: *Hydrologic data collections, *Illinois, *Maps, *Meteorology, *Precipitation, *Rainfall distribution, *Rainstorms, Climates, Data collections, Distribution analysis, Hydrologic data, Spatial distribution, Temporal distribution.

This publication represents a condensed version of an extensive report on the distributions of heavy rainstorms in Illinois, based on data from 61 precipitation stations operating during 1901-1983. Shown are annual frequency distributions of point rainfall for periods ranging from five minutes to ten days and for recurrence intervals varying from 2 months to 100 years. Results are presented in two forms: mean relations for ten regions of approximately homogeneous precipitation, climate, and statewide isohyetal maps based on the 61 station data. The statewide frequency relations provided in this document have been abstracted from a comprehensive report on the frequency distributions and hydroclimatic characteristics of heavy rainstorms in Illinois. The relations are those most commonly used by hydrologists, soil scientists, and others who need information on extreme rainfalls. This publication also addresses other aspects of Illinois extreme rain events, including climatic trends in heavy rainfall frequencies, urban effects on the distribution of heavy rainfall, sampling variability within regions of similar rainfall climate, the seasonable distribution of heavy rainfall events, and other pertinent spatial and temporal characteristics of heavy rainstorms. (Lantz-PTT)
W91-00553

MECA WORKSHOP ON ATMOSPHERIC H2O OBSERVATIONS OF EARTH AND MARS.
For primary bibliographic entry see Field 7B.
W91-00576

EFFECT OF GLOBAL-SCALE DIVERGENT CIRCULATION ON THE ATMOSPHERIC WATER VAPOR TRANSPORT AND MAINTENANCE.
Iowa State Univ., Ames. Dept. of Earth Sciences.
T. C. Chen.
IN: MECA Workshop on Atmospheric H2O Observations of Earth and Mars. Proceedings of the Workshop held September 25-27, 1986. LPI Technical Report No. 88-10, 1988. p 22-28, 5 fig, 6 ref. NSF Grant ATM-8611476.

Descriptors: *Atmospheric circulation, *Atmospheric water, *Climatology, *Meteorology, Atmospheric physics, Monsoons, Seasonal variation.

Many efforts have been made by meteorologists in the past three decades to examine the local maintenance of water vapor by moisture transport. It is difficult to explain the relationship between regions of high water vapor and content and total moisture. The precipitation caused by condensation is often associated with the vertical motion of atmospheric divergent circulation. Based upon this practice, the author shows how the high water vapor content over certain regions is attributed to the convergence by divergent circulations. Two aspects are presented: (1) how the high water vapor content in the tropics during winter and summer seasons is maintained; and (2) how the sudden intensification of tropical divergent circulations associated with monsoon onset enhances the water vapor content over monsoon regions. The data used in this study were generated by the FGGE III-b analyses of the European Center for Medium Range Weather Forecasts. Although water vapor is essentially transported by a rotational component, this study demonstrates that only the water vapor transported by the divergent component is linked to the source and sink, and therefore to the maintenance of atmospheric water vapor content. (See also W91-00576) (Lantz-PTT)
W91-00577

CUMULUS CONVECTION AND TERRESTRIAL WATER-VAPOR DISTRIBUTION.
National Center for Atmospheric Research, Boulder, CO.
L. J. Donner.
IN: MECA Workshop on Atmospheric H2O Observations of Earth and Mars. Proceedings of the Workshop held September 25-27, 1986. LPI Technical Report No. 88-10, 1988. p 41-45, 2 fig, 5 ref.

Descriptors: *Atmospheric water, *Cloud physics, *Convection, *Meteorology, Atmospheric precipitation, Cloud liquid water, Condensation, Precipitation.

Cumulus convection plays a significant role in determining the structure of the terrestrial water vapor field. It also contributes substantially to the momentum and thermal fields. Cumulus convection acts directly on the moisture field by condensing and precipitating water vapor and by redistributing water vapor through cumulus-induced eddy circulations. Additionally, through its radiative and direct interactions with the thermal field, cumulus convection partially establishes the condensation threshold for water vapor. The purpose of this study is to outline the mechanisms by which cumulus convection influences the terrestrial water vapor distribution. This is a problem of enormous complexity, and several theories for its partial resolution exist. Cumulus convection is a dominant mechanism in the transport and removal of atmospheric water vapor in the terrestrial atmosphere. Cumulus parameterizations seek to link the effects of small-scale cumulus convection to the properties of large, synoptic-scale atmospheric flows. Several families of cumulus parameterization exist, differing fundamentally in their basic assumptions. The effects of cumulus convection are most evident in the tropics and baroclinic zones of the middle latitudes, and consist primarily of a mean drying. (See also W91-00576) (Lantz-PTT)
W91-00578

OBSERVATIONS OF ATMOSPHERIC WATER VAPOR WITH THE SAGE II INSTRUMENT.
SASC Technologies, Inc., Hampton, VA.
For primary bibliographic entry see Field 7B.
W91-00579

MEASUREMENTS OF H2O IN THE TERRESTRIAL MESOSPHERE AND IMPLICATIONS FOR EXTRA-TERRESTRIAL SOURCES.
Pennsylvania State Univ., University Park. Dept. of Meteorology.
J. J. Olivero.
IN: MECA Workshop on Atmospheric H2O Observations of Earth and Mars. Proceedings of the Workshop held September 25-27, 1986. LPI Technical Report No. 88-10, 1988. p 71-74, 1 fig, 1 tab, 15 ref.

Descriptors: *Atmospheric water, *Data acquisition, *Meteorology, *Remote sensing, Atmospheric chemistry, Hydrogen, Microwaves, Radiometry.

Water vapor is an important minor constituent in the terrestrial mesosphere. Its photolysis products control ozone above the ozone mixing ration peak; it is radiatively active, especially in the infrared; water sublimes to cause polar mesospheric clouds and possibly other suggested aerosol phenomena; the molecules cluster to form massive ions which dominate the chemistry of the lower ionosphere; and, as the principle hydrogen compound below the mesosphere, it controls the global hydrogen budget and hydrogen escape rate. During the last decade several measurement techniques have been employed to observe H2O at these atmospheric levels. Five data sets were produced by ground-based microwave radiometry. A second group of data sets involves various aircraft and rocket techniques and were observed over a much wider range of latitudes. Ground-base measurements at mid-latitudes strongly support a very dry mesopause-lower thermosphere. Other measurements can be interpreted as being consistent with a high altitude or external source of H2O. The latter process was not seriously considered until very recently, however, these new hypotheses have profound implications for the upper atmosphere of all the planets. (See also W91-00576) (Lantz-PTT)
W91-00580

NIMBUS 7 LIMS WATER VAPOR MEASUREMENTS.
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
E. E. Remsberg, and J. M. Russell.
IN: MECA Workshop on Atmospheric H2O Observations of Earth and Mars. Proceedings of the Workshop held September 25-27, 1986. LPI Technical Report No. 88-10, 1988. p 80-81, 7 ref.

Descriptors: *Atmospheric water, *Data acquisition, *Infrared radiation, *Remote sensing, *Satellite technology, *Water vapor, Measuring instruments, Vapor pressure.

The Limb Infrared Monitor of the Stratosphere (LIMS) experiment on NIMBUS 7 used the technique of thermal infrared limb scanning to sound the composition and thermal structure of the Earth's stratosphere. One of the LIMS channels was spectrically centered at 6.9 micrometers to measure the vertical profile of water vapor radiance from about 15 to 55 km. Data were obtained from late October 1978 until May 1979 over a latitudinal range of 64 S. to 84 N. providing nearly global coverage. The data showed that: (1) there is a pole-ward latitudinal gradient with mixing ratios that increase by a factor of 2 from the Equator to +/-60 degrees at 50 mb; (2) and that most of the time there is a fairly uniform mixing ratio of 5 ppmv at high latitudes, but more variation exists during winter; (3) a well developed hygropause or minimum in mixing ration exists several kilometers above the tropopause at low to mid latitudes; (4) a source region of water vapor exists in the upper stratosphere to lower mesosphere that is consistent with methane oxidation chemistry, at least within the uncertainties of the data; and (5) a zonal mean distribution exists in the lower stratosphere that is consistent with the idea of quasi-isentropic transport by eddies in the meridional direction. (See also W91-00576) (Lantz-PTT)
W91-00581

DETERMINISTIC SIGNALS IN PRECIPITATION IN THE NORTHWESTERN UNITED STATES.
State Univ. of New York at Stony Brook. Inst. for Atmospheric Sciences.
R. G. Currie, and D. P. O'Brien.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1649-1656, July 1990. 7 fig, 5 tab, 35 ref.

Descriptors: *Climatic changes, *Climatology, *Precipitation, *Rain gages, *Weather forecasting, Drought, Idaho, Lunisolar signal, Montana, Wyoming.

Evidence for the 18.6-year lunisolar M(N) signal was found in 91 of 102 rain gage records (89% detection ratio) in the states of Montana, Wyoming, and Idaho, while the 10 to 11-year solar cycle term was detected in 67 of these time series (66% detection ratio). Lunar nodal 19-year M(N) wave trains for these three states show complex patterns, with many experiencing a bistable 180 degree phase switch at epoch 1973.3 (epochs are dates of maximum in tidal forcing). At epoch 1954.7 +/-2.5 years, Wyoming, Montana, and eastern Idaho experienced drought conditions. By epoch 1973 +/-2.5 years, a wet cell of opposite polarity had invaded the eastern half of Montana and parts of eastern Wyoming; concomitantly, drought had expanded westward to include virtually all of Idaho. Bistable 180 degree phase switch-

es in climate parameters were first reported on Patagonian tree ring data and were later found for a flood index in India, a drought index for Beijing, in flooding of the Nile and St. Lawrence Rivers, in air temperature and air pressure records worldwide, and in rainfall for the northeastern United States and the corn belt. (Author's abstract)
W91-00609

OXIDATION OF S(IV) IN RAIN-WATER COLLECTED IN JAPAN.
Institute of Public Health, Tokyo (Japan).
For primary bibliographic entry see Field 5B.
W91-00668

ORIGIN OF SOLUBLE CHEMICAL SPECIES IN BULK PRECIPITATION COLLECTED IN TOKYO, JAPAN: STATISTICAL EVALUATION OF SOURCE MATERIALS.
Tokyo Inst. of Tech. (Japan). Dept. of Environmental Chemistry and Engineering.
For primary bibliographic entry see Field 5B.
W91-00670

MESOSCALE MODELING OF ACIDITY PRODUCTION IN OROGRAPHIC CLOUDS AND RAIN.
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. Associe de Meteorologie Physique.
For primary bibliographic entry see Field 5B.
W91-00671

WATERBIRDS DYNAMICS AT BOOL LAGOON, SOUTH AUSTRALIA, 1983-87.
Australian National Parks and Wildlife Service, Berri.
For primary bibliographic entry see Field 2H.
W91-00686

MAGPIE GOOSE, ANSERANUS SEMIPALMATA, NESTING ON THE MARY RIVER FLOODPLAIN, NORTHERN TERRITORY, AUSTRALIA: EXTENT AND FREQUENCY OF FLOODING LOSSES.
Conservation Commission of the Northern Territory, Darwin (Australia).
For primary bibliographic entry see Field 2H.
W91-00688

ATMOSPHERIC CHEMISTRY OF PEROXIDES: A REVIEW.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W91-00841

FIELD INVESTIGATIONS ON THE SNOW CHEMISTRY IN CENTRAL AND SOUTHERN CALIFORNIA-I. INORGANIC IONS AND HYDROGEN PEROXIDE.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W91-00842

COMPARISON OF TWO CLOUDWATER/FOGWATER COLLECTORS: THE ROTATING ARM COLLECTOR AND THE CALTECH ACTIVE STRAND CLOUDWATER COLLECTOR.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 7B.
W91-00844

WET AND DRY DEPOSITION FLUXES ABOVE THE NORTH SEA.
Vrije Univ., Brussels (Belgium). Dienst Analytische Scheikunde en Geochemie.
W. Baeyens, F. Dehairs, and H. Dedeurwaerder.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1693-1703, July 1990. 5 fig, 6 tab, 25 ref. California Air Resources Board Contract AG-185-32.

Descriptors: *Air pollution, *Atmospheric chemistry, *Chemistry of precipitation, *Dry deposition, *Heavy metals, *North Sea, *Wet deposition, Cadmium, Chemical composition, Copper, Fluctuations, Iron, Lead, Manganese, Model studies, Precipitation, Rainfall, Sodium, Zinc.

Annual wet and dry metal fluxes to the Southern Bight of the North Sea have been estimated at the West-Hinder station about 50 kilometers off the coast of Belgium. The troposphere of the Southern Bight is surrounded by some of the most industrialized countries and subject to important meteorological variations. Between the dissolved metal concentrations in rain water and the precipitation volume a hyperbolic-like dilution profile was observed. The range of wet metal fluxes for the North Sea were determined to be Cu(1.05-2.8), Cd(0.15-0.42), Mn(0.47-1.6), and Na(745-2700). Pb(0.18-1.1), Zn(3.1-18.4), and Fe(3.54-19.5) showed a broader range. All values are expressed as micrograms/square centimeter/year. Dry deposition fluxes at sea were measured using vasilinated plexiplates, and calculated using dry deposition model and cascade impactor results. Despite the large uncertainties on the calculated dry deposition fluxes, results obtained by both methods agree within a factor of 2.3. Finally, for Na, Cu, Zn, and Cd, wet fall-out is probably the predominant deposition process. For Mn, Pb, and Fe, the wet and dry fall-out may be of the same magnitude. (Korn-PTT)
W91-00845

INTENSIVE STUDIES OF SIERRA NEVADA CLOUDWATER CHEMISTRY AND ITS RELATIONSHIP TO PRECURSOR AEROSOL AND GAS CONCENTRATIONS.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
J. L. Collett, B. D. Daube, D. Gunz, and M. R. Hoffmann.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1741-1757, July 1990. 13 fig, 5 tab, 48 ref. California Air Resources Board Contract A6-185-32.

Descriptors: *Acid rain, *Aerosols, *Air pollution, *Ammonia, *Ammonium, *Cloud chemistry, *Organic acids, *Path of pollutants, *Precipitation scavenging, Aerosol-gas equilibrium, California, Chemical interactions, Chemistry of precipitation, Cloud liquid water, Hydrogen peroxide, Nitrates, Nitric acid, Sequoia National Park, Sierra Nevada, Sulfates, Sulfites.

Measurements of inorganic aerosol and gas phase species were conducted at fir three sites in central California during a 4 day period in April 1988. The measurement sites were located along an east-west transect at Visalia, Ash Mountain, and Lower Kaweah, with elevations of 90, 550, and 1900m, respectively. Aerosol compositions were nearly neutral at all locations, however, large concentrations of NH3 at Visalia contributed significant excess alkalinity to the air mass sampled there. Concentrations of all major species were observed to decrease with elevation during most of the sampling periods. Concentrations at the upper two sites exhibited diurnal fluctuations, with peaks in the late afternoon, consistent with the transport of pollutants from San Joaquin Valley sources by daytime upslope winds. Concentrations of most of the species reached a maximum at the elevated sites on 28 April, as a weak cold front approached, reducing the atmospheric stability over the valley floor. Concentrations at Visalia on this day were somewhat lower than those observed earlier in the week. Clouds intercepting the mountain slopes on 28 April were sampled at two locations. The cloud water pH at both sites was observed to fall throughout the event, dropping as low as 4.34. Precursor concentrations of aerosol NO3(-), SO4(2-), and NH4(+), and gas phase HNO3 and NH3, were sufficient to account for the observed cloudwater loadings of NO3(-), SO4(2-), and NH4(+). In-cloud measurements made near the cloud base indicated a considerable S(IV) oxidation potential in the form of H2O2, but only low S(IV) concentrations. Cloud water concentrations of formic acid were approximately three times acetic acid concentrations. Carbonyl concentrations were dominated by formaldehyde and glyoxal. (Author's abstract)
W91-00846

CHEMICAL CHARACTERIZATION OF ACID PRECIPITATION IN ALBANY, NEW YORK.
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
For primary bibliographic entry see Field 5A.
W91-00850

SOURCE-RECEPTOR RELATIONSHIPS FOR WET SO4(2-) AND NO3(-) PRODUCTION.
For primary bibliographic entry see Field 5B.
W91-00851

RADIOMETRIC STUDIES OF CLEAR AIR ATTENUATION AND ATMOSPHERIC WATER VAPOR AT 22.235 GHZ OVER CALCUTTA (LAT. 22 DEGREES 32 MINUTES N, LONG. 88 DEGREES 20 MINUTES E).
Calcutta Univ. (India). Inst. of Radiophysics and Electronics.
A. K. Sen, P. K. Karmakar, A. Mitra, A. K. Devgupta, and M. K. Dasgupta.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1909-1913, July 1990. 4 fig, 2 tab, 8 ref.

Descriptors: *Atmospheric water, *Data acquisition, *India, *Radiometry, *Water vapor, Calcutta, Microwaves, Monsoons, Seasonal variation, Water properties.

Water vapor, an important minor atmospheric constituent can impose serious limitations to the propagation of radio waves, especially microwave and millimeter wave band. Moreover, it can affect the thermodynamic balance, photochemistry of the atmosphere, sun-weather relationships, and the biosphere. Measurements of the vertical and horizontal distribution of water vapor as well as its temporal variations were conducted for the year 1985-1986 using a microwave radiometer tuned to the thermal emission line of water vapor at 22.235 GHz. Analyses of the data obtained reveals that the antenna temperature attains a maximum of about 160 K in the monsoon months (June-September) and minimum of about 80 K in the winter months (December-February). A similar trend is exhibited by the variation of attenuation data. It reveals that the attenuation values under clear weather conditions for different seasons vary between 1 and 4 dB for the entire year. The average attenuation is 2.41 dB for the pre-monsoon period and 1.18 dB for the post-monsoon period. An attempt is also made to determine the monthly variation of noise temperature, attenuation and water vapor content. It is noted that each of the variations closely resembles the variational pattern of water vapor content. This suggests that the 22.235 GHz emission noise temperature and attenuation may originate mainly from the water vapor present in the atmosphere. (Korn-PTT)
W91-00852

CHEMICAL COMPOSITION DIFFERENCES IN FOG AND CLOUD DROPLETS OF DIFFERENT SIZES.
California Inst. of Tech., Pasadena. Dept. of Chemical Engineering.
S. N. Pandis, J. H. Seinfeld, and C. Pilinis.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1957-1969, July 1990. 12 fig, 1 tab, 28 ref. California Air Resources Board Agreement A732-043.

Descriptors: *Acid rain, *Air pollution, *Chemistry of precipitation, *Cloud liquid water, *Fog, *Sulfates, *Water chemistry, Cloud chemistry, Fluid drops, Mathematical studies, Particle size.

The distribution of acidity, and solute concentrations, among the various droplet sizes in a fog or cloud, and the effect of the evaporation-condensation cycle on the composition and size distribution of atmospheric aerosols is studied. Significant total solute concentration differences can occur in aqueous droplets inside a fog or cloud. In fog which

was simulated during a period of dense fog, the solute concentration in droplets > 10 micrometers in diameter increased with size. Droplets with diameters of 20 micrometers attain a solute concentration that is 3.6 times larger than in 10 micrometer droplets. Droplets on which most of the liquid water condenses have access to most of the reacting medium for in situ S(IV) oxidation and are therefore preferentially enriched with sulfate. Gas and aqueous phase chemical processes result in an increase of the total solute mass concentration nonuniform over the droplet spectrum for a mature fog. These chemical processes tend to decrease the total solute mass concentration differences while high cooling rates have the opposite effect. The mass/size distribution of the condensation nuclei influences quantitatively, but not qualitatively, these concentration differences. (Author's abstract)
W91-00854

RAINFALL DEFICITS: DISTRIBUTION OF MONTHLY RUNS.
Canterbury Regional Council, Christchurch (New Zealand).
G. A. Griffiths.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 219-229, July 1990. 2 fig, 2 tab, 27 ref.

Descriptors: *Drought, *Meteorology, *Model studies, *Probabilistic process, *Rainfall, *Simulation, Data analysis, Seasonal variation, Statistical analysis.

A probabilistic model is derived to describe temporal series of monthly rainfall deficits in terms of the number of runs, run length and rainfall depth per run. A rainfall deficit is defined as a submedial value in a set of rainfalls which have equal durations. With allowance for symmetry, the joint distribution is also applicable to surfeits or supramedial values. Classic run theory supplies exact, parameter-free, probability density functions for a number of runs and run lengths. Some simple assumptions on the generation of deficit rainfalls lead to a two-parameter gamma density for rainfall depth per run. The model was tested with 130 years of data from a rainfall station and its use in estimating an extreme value distribution of minima and in determining properties of the longest expected deficit run length in a stated period was demonstrated. The theoretically based model should provide a useful description of temporal rainfall patterns of varying durations particularly for the application of statistical decision theory to problems concerning hydrological drought. (Author's abstract)
W91-00886

EFFECT OF OBLIQUE RAIN ON INCLINED SURFACES: A NOMOGRAPH FOR THE RAINGAUGE CORRECTION FACTOR.
Agricultural Univ., Wageningen (Netherlands). Dept. of Hydraulics and Catchment Hydrology.
For primary bibliographic entry see Field 7B.
W91-00899

STUDY ON SHORT-TERM RAINFALL PREDICTION BY RADAR RAINGAUGE.
Public Works Research Inst., Tsukuba (Japan).
K. Ishizaki, F. Yoshino, K. Takeuchi, and A. Yoo.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 3-12. 6 fig, 3 tab, 14 ref.

Descriptors: *Advection, *Hydrologic models, *Meteorology, *Radar, *Rain gages, *Rainfall, *Rainfall forecasting, *Weather forecasting, Data acquisition, Echo-tracking method, Japan, Nagasaki, Storms.

A short-term rainfall prediction model using the echo-tracking method was applied to a number of rainfall cases to determine the accuracy of the model. The accuracy of one-hour prediction proved to be practical. The echo-tracking method and the advection model method were compared by applying them to the Nagasaki Storm of July 1982. The results confirmed that a storm rainfall can be predicted one hour before it occurs and that there is little difference in prediction accuracy between these methods. (See also W91-00961) (Author's abstract)
W91-00962

TOWARDS AN IMPROVED SYSTEM FOR WEATHER RADAR CALIBRATION AND RAINFALL FORECASTING USING RAINGAUGE DATA FROM A REGIONAL TELEMETRY SYSTEM.
Institute of Hydrology, Wallingford (England).
R. J. Moore, B. C. Watson, D. A. Jones, K. B. Black, and C. M. Hagget.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 13-21, 7 fig, 5 ref.

Descriptors: *Flood forecasting, *Flood warning systems, *Meteorological data collection, *Radar, *Rain gages, *Rainfall, *Rainfall forecasting, *Telemetry, *Weather forecasting, Computers, Data acquisition, England, Instrumentation, London, Rainfall distribution.

The UK weather radar network is approaching completion and attention is being focussed on its better use by the water industry for hydrological application. A feature of the national network design is that a small number of rain gages, typically five, is provided for calibration of each radar. However, regional water authorities can have as many as ten times this number of rain gages as part of a centrally controlled regional telemetry system. Current research, carried out as a collaborative venture between the Thames Water Authority and the Institute of Hydrology, addresses the problem of how to obtain more accurate and robust estimates of spatial rainfall through the combined use of weather radar and a regional network of telemetering rain gages. A way of fitting multiquadric surfaces to the ratios of gauge to coincident radar grid square rainfall is among the procedures being investigated. Recent progress in the development of a regional forecasting system for rainfall for small space-time resolutions and model lead times is outlined. Two procedures for identifying the speed and direction of storm movement from weather radar grid square data are based on local and regional correlation matching techniques respectively. New procedures developed as part of the research program will be incorporated in a computer-controlled flood forecasting system developed for flood warning in the London area. (See also W91-00961) (Author's abstract)
W91-00963

USE OF SATELLITE DERIVED RAINFALL ESTIMATES AS INPUTS TO FLOW PREDICTION IN THE RIVER SENEGAL.
Reading Univ. (England). Dept. of Meteorology.
S. Hardy, G. Dugdale, J. R. Milford, and J. V. Sutcliffe.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 23-30. 5 fig, 2 tab, 4 ref.

Descriptors: *Meteorological data collection, *Rainfall, *Remote sensing, *River flow, *River forecasting, *Satellite technology, *Streamflow forecasting, Africa, Catchment areas, Data acquisition, Meteosat, Model studies, Rain gages, Senegal.

The accuracy obtainable in river flow forecasts when rainfall estimates based on data from the geostation are satellite Meteosat are input to catchment models in place of rain gage data was investigated. Particularly where the rain gage network is sparse or communications are unreliable, the complete and regular coverage provided by satellite is a major advantage for real-time, operational flow forecasting. Preliminary results are presented from a research program in which catchment model outputs were compared on a daily basis with river flow observations. After selecting the most appropriate model, the study tested the effect on the calculated flow at two gaging stations of using the distributed rainfall estimated from Meteosat in place of rain gage data. The model results were compared with the measured flows of the subcatchments. The chosen rainfall-runoff model performed at least as well when satellite-based rainfall estimates are used as input in place of normal rain gage data. This has important implications as it makes available real-time flow forecasting and flood warning in the Senegal basin. If the methodology is found to provide substantial advantages it will also be applicable to other catchments in sensitive areas of Africa. (See also W91-00961) (Sand-PTT)
W91-00964

AREAL REDUCTION FACTORS FOR DESIGN STORM CONSTRUCTION: JOINT USE OF RAINGAUGE AND RADAR DATA.
Institute of Hydrology, Wallingford (England).
E. J. Stewart.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 31-40, 5 fig, 2 tab, 11 ref. UK Department of the Interior Contract PECD7/7/190.

Descriptors: *Design storms, *Flood forecasting, *Meteorological data collection, *Radar, *Rain gages, *Rainfall, *Remote sensing, Data acquisition, England.

The spatial variability of rainfall was analyzed in an upland region in North West England using both rain gage and weather radar data. Two differing methodologies are outlined for the re-evaluation of area reduction factors in the study area for a range of durations. Areal reduction factors for durations of 1, 2, 4, and 8 days are presented which are slightly lower than those currently accepted as applicable throughout the UK. Areal reduction factors decreased with return period, but vary little with location within the study area. Preliminary results of the analysis of the ratios of short duration rainfalls to 1-day rainfalls show that the ratios for the North West are generally greater than those derived from the Flood Studies Report (FSR). The rainfall totals in each duration were derived from the hourly radar data using a running sum method within the rainfall day itself. Since durations were not allowed to extend into the subsequent rainfall day, the ratios ascribed to the 2 to 12-hour durations can be taken to apply to slightly shorter actual durations. This has the effect of increasing the difference between the ratios for the North West and the FSR. (See also W91-00961) (Sand-PTT)
W91-00965

ACCURACY OF THE MAXIMUM RECORDED DEPTH IN EXTREME RAINSTORMS.
Iowa State Univ., Ames. Dept. of Civil Engineering.
E. Foufoula-Georgiou.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 41-49. 4 fig, 15 ref. NSF Grant CES-8708825.

Descriptors: *Rainstorms, *Statistical analysis, Error analysis, Rain gages, Rainfall distribution, Storms.

The actual maximum depth of a storm is seldom measured but is usually approximated by the maximum recorded depth. These depths can be quite different depending on the rain gage density and the spatial rainfall pattern. This paper presents a simplified error analysis of the actual maximum depth of a storm and provides an estimate of the first three moments of the normalized error e = (actual maximum depth-maximum recorded depth)/actual maximum depth as a function of the rain gage density. Such results may be useful in devising storm depth adjustment procedures when

storms of different spatial patterns and variable density recording networks are combined in storm regionalization or storm transposition studies. (See also W91-00961) (Sand-PTT)
W91-00966

INFLUENCE OF THE ANGLE OF INCIDENCE OF THE RAINFALL ON THE OVERLAND FLOW PROCESS.
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 2J.
W91-00969

FLOODS AND DROUGHTS IN LABE RIVER BASIN: THE HYDROGRAPH SHAPE.
Hydrometeorologicky Ustav, Prague (Czechoslovakia).
For primary bibliographic entry see Field 2E.
W91-00975

OPERATIONAL SNOW ACCUMULATION AND SNOWMELT MODELING.
National Board of Waters, Helsinki (Finland). Hydrological Office.
V. Vehvilainen.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 213-222. 6 fig, 2 tab, 7 ref.

Descriptors: *Hydrologic models, *Mathematical models, *Model studies, *Runoff forecasting, *Snow accumulation, *Snowmelt, Costs, Finland, Forecasting, Precipitation, Watersheds.

The modified HBV-3 watershed model has been in use since 1981 for operational springtime forecasting in Finland. This model is in use in 13 watersheds ranging from 500-30,000 sq km. In order to improve the results of the springtime forecast research has been conducted to develop more physical snowmelt models and to test the ability of snow models to estimate areal snow water equivalent over the accumulation period in winter. It is shown that this modeling can produce estimates of areal water with the same accuracy as methods based on snow course measurements. The problem in model estimation of areal water equivalent is to arrange the collection of precipitation data from all precipitation stations. The cost of estimation of areal water equivalent with the model will be moderate compared to other forecasting methods. (See also W91-00961) (Sand-PTT)
W91-00983

NEW PERSPECTIVES ON DEVELOPMENTS IN MODELING OF EFFECTIVE RAINFALL BY APPLYING THE FDTF METHOD (NOUVELLES PERSPECTIVES DE DEVELOPPEMENT DANS LA MODELISATION DES PLUIES EFFICASES PAR APPLICATION DE LA METHODE DPFT).
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 2E.
W91-00985

2C. Snow, Ice, and Frost

CLASSIFICATION OF UNIDIRECTIONAL THREE-LAYER FLOW OVER A HUMP.
Contra Costa Water District, Concord, CA.
For primary bibliographic entry see Field 8B.
W91-00041

VARIABLE LAPSE RATE SNOWLINE MODEL FOR THE REMARKABLES, CENTRAL OTAGO, NEW ZEALAND.
Department of Scientific and Industrial Research, Christchurch (New Zealand). Land and Soil Science Div.
J. R. F. Barringer.
Journal of Hydrology (New Zealand) JLHYAD, Vol. 28, No. 1, p 32-46, 1989. 5 fig, 3 tab, 29 ref.

Descriptors: *Mathematical models, *Model studies, *Snow, *Snowline, *Snowpack, Ablation, Alpine regions, Mountains, New Zealand, Snow accumulation.

Studies of snow accumulation and ablation have been conducted using snowmelt-stream runoff relationships or linear lapse rates to extrapolate low altitude temperature and rainfall. The relevance of these relationships to the problem of obtaining estimates of winter snowlines was examined. Temperature extrapolation using fixed linear lapse rates was identified as a major source of error in previous studies. Simulations based upon measured and interpolated temperature data from three high altitude meteorological stations on the Remarkables, Central Otago, show that the standard modeling routines used are essentially sound, allowing daily snowlines to be modeled with reasonable accuracy. A variable lapse rate technique provided more accurate prediction of high altitude temperatures. Actual snowlines were determined by aerial photography. Discriminant analysis based on high altitude temperatures and low altitude standard meteorological records can be successfully applied as an alternative method of temperature extrapolation, providing a marked improvement on previous extrapolation techniques. Using this technique, it should be possible to reconstruct snowline data when upper mountain temperature data are not available. (Author's abstract)
W91-00076

ESTIMATED RUNOFF FROM MAN-MADE SNOW.
Wright Water Engineers, Inc., Denver, CO.
L. M. Eisel, K. M. Bradley, and C. F. Leaf.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 519-526, June 1990. 3 fig, 4 tab, 3 ref.

Descriptors: *Artificial precipitation, *Colorado, *Consumptive use, *Snowmaking, *Water loss, Alpine regions, Recreation, Runoff, Snow skiing, Snowpack.

The consumptive loss from snowmaking at six Colorado ski areas was calculated. The focus of the investigation was on the consumptive loss that occurs to man-made snow particles during the period they reside on or in the snowpack until spring snowmelt (termed the watershed loss). Calculated watershed losses under a variety of precipitation and temperature conditions at six ski areas varied from 7% to 33%. These calculations were made using the calibrated Subalpine Water Balance Simulation Model. The watershed loss of 7% to 33% indicates the range of likely watershed losses that can be expected at Colorado ski areas. A previously published paper provided estimates of the mean consumptive loss during the snowmaking process (termed initial loss) for conditions existing at Colorado ski areas to be 6% of water applied. Therefore, based on the mean initial loss, the total consumptive loss from man-made snowmaking under conditions found at Colorado ski areas could be expected to range from 13% to 37%. These results demonstrate the range of total consumptive losses that could be expected in various years and for various watershed conditions. These total percentage losses cannot be extrapolated directly to other specific sites because the total consumptive loss is dependent on temperature during actual snowmaking, temperature and precipitation throughout the winter at the specific ski area, and watershed conditions at the ski area. (Author's abstract)
W91-00092

SPRING BREAK-UP IN NORTHERN CANADA PAST AND PRESENT.
Lakehead Univ., Thunder Bay (Ontario). Dept. of Geography.
D. D. Kemp.
Weather WTHRAL, Vol. 45, No. 5, p 183-186, May 1990. 2 fig, 4 ref.

Descriptors: *Canada, *History, *Ice breakup, Ice, Ice jams, Social aspects, Spring breakup, Springs.

In the Canadian north, the coming of spring is marked by the rapid melting of the winter's accumulation of snow and the break-up of ice on rivers and lakes. This period produces short-term disruption in the lives of remote northern communities. Excess surface moisture makes dirt roads impassable and gravel airstrips dangerous to use. Waterways become unsuitable for boat traffic and floatplants. All of this increases the isolation of many northern communities, but with proper planning and the use of modern technology, such as the helicopter, the consequences of spring break-up can be minimized. Historically, conditions on the rivers and lakes were of major concern to the traders, and from an early date, the clerks and officers of the Hudson's Bay and North West Companies included references to such conditions in their journals. Journal entries from Pond's Fort on the Athabasca River start on April 1, 1786. They reveal the typically changeable weather conditions of late winter and early spring. Spring break-up appears to have been almost two weeks early in 1786. With appropriate allowances for language and spelling the journal account might well have described the events associated with spring break-up at the present time. Missing from the journal entries is any sense of major concern, and there is every indication that life went on much as usual. (Mertz-PTT)
W91-00116

DIFFERENTIAL REFLECTIVITY RADAR HAIL MEASUREMENT TECHNIQUE: OBSERVATIONS DURING THE DENVER HAILSTORM OF 13 JUNE 1984.
Pennsylvania State Univ., University Park. Communications and Space Sciences Lab.
K. Aydin, Y. Zhao, and T. A. Seliga.
Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 7, No. 1, p 104-113, February 1990. 4 fig, 3 tab, 53 ref. Army Research Office, Geoscience Division Contracts DAAL03-87-K-0031 and DAAL03-89-K-0158.

Descriptors: *Colorado, *Data acquisition, *Hail, *Precipitation mapping, *Radar, *Remote sensing, Convective precipitation, Ice, Melting, Particle size, Storms.

Multiparameter-polarimetric radars are increasingly being used for studying the microphysics of convective storms. A differential reflectivity radar technique for observing hailstorms was utilized during the 13 June 1984 Denver hailstorm. The hail regions of the storm were identified with the differential reflectivity hail signal. Histograms of the effective reflectivity factor Z(H) and the differential reflectivity Z(DR) were generated for different heights in the hail regions and the relative variation of these parameters was determined. It was observed that due to melting, the mean values of Z(H) and Z(DR) increased with decreasing height below the 0 deg level (around 2.6 km above ground level). Furthermore, at the lower levels Z(DR) varies between -1 and +2 dB, and Z(H) is generally greater than 50 dBZ. The value of Z(H) peaked at around 60 dBZ or more when Z(DR) was in the range -0.5 to 0 dB and 1.5 to 2 dB at 1.5 km and 2 km below the 0 deg level. These and other features of Z(H) and Z(DR) were interpreted in terms of the size, shape and fall behavior of the hailstones using the dual wavelength ratio and the linear depolarization ratio radar measurements, together with results from scattering computations. The negative Z(DR) regions in the storm were inferred to be composed of melting hailstones with sizes predominantly in the 12 to 40 mm range; size falls when larger dimensions are aligned (on the average) vertically. Positive Z(DR) values greater than 1 dB were concluded to be due to melting hailstones with sizes less than 12 mm; size here falls when larger dimensions are aligned (on the average) horizontally. (Author's abstract)
W91-00140

EFFECTS OF SUBURBANIZATION UPON SNOWMELT RUNOFF.
Trent Univ., Peterborough (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2E.

W91-00408

HYDROLOGICAL REMOTE SENSING RESEARCH WITH LARGE-SCALE APPLICATIONS IN WESTERN EUROPE.
Zurich Univ. (Switzerland). Remote Sensing Labs.
For primary bibliographic entry see Field 7B.
W91-00455

USE OF SATELLITE MICROWAVE RADIOMETERS FOR LARGE-SCALE HYDROLOGY.
Innsbruck Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
For primary bibliographic entry see Field 7B.
W91-00457

EFFECTS OF CLIMATE CHANGE ON SNOWMELT RUNOFF PATTERNS.
Eidgenoessisches Inst. fuer Schnee- und Lawinenforschung, Davos (Switzerland).
J. Martinec, and A. Rango.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 31-38, 7 fig, 1 tab, 4 ref.

Descriptors: *Alpine regions, *Global warming, *Model studies, *Mountains, *Precipitation, *Runoff, *Snowmelt, Air temperature, Climates, Seasonal variation, Snow cover.

A doubling of atmospheric CO2 content in the next century as a result of the greenhouse effect could increase global temperatures by 3 degrees C and have a variable effect on precipitation. Effects such as these will have a direct influence on the hydrological regime. In mountainous areas, snowmelt patterns would be affected by changed temperatures so that the runoff from snowmelt would be increased and redistributed during the snowmelt season and possibly increased during the winter months. Three mountainous basins in Canada, USA, and Europe were selected to study the potential effects on snowmelt runoff using a snowmelt runoff simulation model. The runoff in a snowmelt season was simulated using measured temperature, precipitation, and remotely-sensed snow covered area. The simulation was repeated using the changed values of variables according to the predicted future climate. In the three basins studied in response to a 3 degree C temperature increase, snowmelt season runoff was increased on the average by about 10% and the runoff in April (+121%) and May (+65%) was increased the most with the months June-September experiencing decreases or no change. Changes in precipitation of -5%, +5%, and +10% during the snowmelt season seemed to have only minimal effects on the runoff. It is speculated that precipitation changes during the winter accumulation season will have more significant effects on runoff. Finally, the new climate would distinctly change the appearance of the mountain basins in May and June because the snow covered areas will be reduced much more rapidly. (See also W91-00454) (Author's abstract)
W91-00458

GLOBAL WATER BALANCE AND GLOBAL CLIMATE MODEL IN THE PLEISTOCENE.
Akademiya Nauk SSSR, Moscow. Inst. Geografii.
A. B. Kazanskiy.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 39-45, 1 fig, 10 ref.

Descriptors: *Climatology, *Glaciers, *Hydrologic budget, *Paleoclimatology, *Paleohydrology, Evaporation, Mathematical analysis, Sea level.

It has been widely suggested that the main ocean level change cycle in the pleistocene had an approximate period of 100,000 yr, which does not conform to paleotemperature measurements. These have a much longer period than the main period of ocean level change. This contradiction has been investigated by analyzing a previously published global water balance equation. This equation has been put into a form in which the ocean level variation and the amount of the average 'effective' evaporation per unit area from the world's ocean surface (evaporation minus rainfall) are unknown. With this equation it is possible to demonstrate the smallness of relative variation of 'effective' evaporation when continental ice sheets degrade, but its effect becomes perceptible when ice sheets are growing. This conclusion is confirmed by estimates of ocean level changes during the last 17,000 yr B.P. Further analysis based on this equation resulted in a model relating the main paleotemperature cycle with the main ocean level changes cycle. (See also W91-00454) (Author's abstract)
W91-00459

SATELLITE DETERMINATION OF COAST RANGE, ALASKAN GLACIER MASS BALANCE RELATED TO ATMOSPHERIC CIRCULATION.
Maine Univ. at Orono. Inst. for Quaternary Studies.
M. S. Pelto.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 127-137, 3 fig, 3 tab, 15 ref.

Descriptors: *Climatology, *Glaciers, *Remote sensing, *Satellite technology, *Snowline, Ablation, Air temperature, Alaska, Arctic zone, British Columbia, Coast Range, Global warming, Precipitation.

Annual balance is determined for 90 glaciers in the Coast Range of Alaska-British Columbia, using a technique based on satellite imagery identification of the snowline position at various times during the ablation season, and the equilibrium line position observed at the end of the ablation season. This method allows annual balance calculation with an accuracy of +/-0.25 m/yr. During the 1981 through 1984 hydrologic years the mean annual temperature in the Coast Range region was 1.4 C above normal and precipitation 15% below normal, and the mean annual balance of Coast Range glaciers was -0.6 m/yr. During the 1985 through 1987 hydrologic years, mean annual temperature was 1.8 C above normal, precipitation was 30% above normal, and mean annual balance was +0.7 m/yr. The average terminus fluctuation of the 90 Coast Range glaciers observed was -11 m/yr during the 1973-1987 period, the smallest retreat rate of this century. (See also W91-00454) (Author's abstract)
W91-00468

DETERMINATION OF SNOW WATER EQUIVALENTS BY USING NOAA-SATELLITE IMAGES, GAMMA RAY SPECTROMETRY AND FIELD MEASUREMENTS.
Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).
R. Kuittinen.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 151-159, 2 fig, 2 tab, 20 ref.

Descriptors: *Finland, *Remote sensing, *Satellite technology, *Snowmelt, Cloud cover, Errors, Gamma radiation, Model studies, Snowpack, Spectrometry.

A method was developed to estimate areal snow water equivalents during snow melt in lowland areas of Finland by using NOAA/AVHRR images, airborne gamma ray spectrometry and field measurements. The errors were 20-50 mm for satellite images and 5-10% of the snow equivalent for gamma ray spectrometry. The results of field measurements can be combined with remotely sensed data. Because cloud cover prevents the use of satellite imagery, a snow melt equation is used to estimate snowmelt on cloudy days. Areal snow water equivalents were estimated with an error between 15 and 45 mm in the spring of 1986. (See also W91-00454) (Author's abstract)
W91-00470

MULTISPECTRAL SNOW AREA ALGORITHM FOR OPERATIONAL 7-DAY SNOW COVER MONITORING.
Bristol Univ. (England). Remote Sensing Unit.
R. M. Lucas, A. R. Harrison, and E. C. Barrett.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 161-166, 2 fig, 10 ref.

Descriptors: *England, *Remote sensing, *Satellite technology, *Snow cover, *Snowpack, Algorithms, Coniferous forests, Data interpretation, Forests, Infrared imagery, Mapping, Multispectral techniques, Snowmelt.

A potentially operational snow mapping scheme which is applicable to areas of temporary snow cover (e.g. United Kingdom) uses daily NOAA AVHRR imagery for the production of weekly composite snow area estimates. This technique is based upon an unsupervised multispectral classification of AVHRR channels allowing snow/cloud and snow type discriminations together with the accurate location of snowpack margins. Masking of the snowpack by conifer forest is less extensive in the UK than in other snow covered regions. Areas of obscured snow not detected by classifier can be identified by overlaying a digitized forest areas map onto each image and applying an appropriate interpolation procedure. Snow area maps derived on a daily basis using the multispectral technique are co-registered to produce snow duration maps for selected periods and images detailing the pattern of snowmelt over time. Areas where data are lacking can be compensated for by employing ground station and digital terrain data. Supporting sub-routines have been developed also for the correction of forest masking and shadowing of the snow by cloud. (See also W91-00454) (Author's abstract)
W91-00471

EFFECT OF TOSTON DAM ON UPSTREAM ICE CONDITIONS.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 6G.
W91-00574

ZERO-CURTAIN EFFECT: HEAT AND MASS TRANSFER ACROSS AN ISOTHERMAL REGION IN FREEZING SOIL.
Michigan Univ., Ann Arbor. Dept. of Geological Sciences.
S. I. Outcalt, F. E. Nelson, and K. M. Hinkel.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1509-1516, July 1990. 5 fig, 23 ref, append.
National Science Foundation Grants DPP-8117124 and SES-8722676.

Descriptors: *Freezing soil, *Frost, *Frozen ground, *Soil temperature, *Thermal properties, *Zero-curtain effect, Alaska, Arctic zone, Heat transfer, Mass transfer, Michigan, Permafrost, Thawing, Vapor transport.

The term zero curtain refers to the effect of latent heat in maintaining temperatures near 0 C over extended periods in freezing or thawing soils. Analysis of thermal data from an arctic site (Toolik Lake, Alaska) and a mid-latitude location (Ann Arbor, Michigan) suggests that the phenomenon may be a universal characteristic of wet, medium-textured mineral and organic soils during freezing. Nonconductive processes play an important role in formation and maintenance of the zero-curtain effect. Water advection, condensation, and evaporation events are recognizable in mappings of thermal and ion concentration records on time-depth meshes. The zero curtain appears to be produced and maintained by vapor transport and internal distillation mechanisms, driven by osmotic potential variations induced by freeze-thaw events at the soil surface. The term zero curtain is applicable to locations outside permafrost regions, but units of measurements should not be assigned to it. (Author's abstract)
W91-00597

SALTATION OF SNOW.
National Hydrology Research Inst., Saskatoon (Saskatchewan).
J. W. Pomeroy, and D. M. Gray.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1583-1594, July 1990. 8 fig, 1 tab, 40 ref. Natural Sciences and Engineering Research Council of Canada Grant A4363.

Descriptors: *Drifting snow, *Saltation, *Snow cover, Mathematical models, Snow sampling, Transport rate, Wind, Wind velocity.

Redistribution of surface snow by wind transport significantly affects the winter microclimate, snow cover accumulation, and hence snowmelt runoff patterns in cold, windswept regions. Saltation of snow, the transport of snow in periodic contact with and directly above the snow surface, is governed by atmospheric shear forces applied to the erodible snow surface, the nonerodible surface, and the moving snow particles. Empirical data measured over a snow-covered plain suggests functions for parameters important to the apportionment of atmospheric shear forces; the aerodynamic roughness height during saltation, the mean horizontal velocity of saltating particles, and the efficiency of the saltation process. The resulting mass transport expression shows an approximately linear increase in snow saltation transport rate with friction velocity, in agreement with the measurements presented. The expression is sensitive to the cohesion of the snow surface, as indexed by the threshold wind speed, that wind speed at which transport ceases; for wind speeds well above the threshold condition, higher threshold wind speeds correspond to higher transport rates. An adaptation of the expression allows calculation of the mass concentration of saltating snow from measured data and the transport rate of saltating snow from the mean wind speed at 10 m height. Application of the transport rate expression using measured wind speeds, directions, and weather observations demonstrates that the directional component of annual saltating snow transport does not always correspond with wind direction frequency. (Author's abstract)
W91-00603

PHYSICAL CHEMICAL PROPERTIES OF UNCHARGED WATER CLUSTERS AND ONE-DIMENSIONAL ICE BASED ON QUANTAL CALCULATIONS.
Missouri Univ.-Rolla. Dept. of Physics.
D. E. Hagen, C. K. Lutrus, and S. H. S. Salk.
Atmospheric Environment ATENBP, Vol. 24A, No. 6, p 1391-1396, June 1990. 5 fig, 1 tab, 45 ref. NSF Grant ATM-8716918.

Descriptors: *Freezing, *Ice, *Ice formation, *Physical properties, *Thermodynamics, *Water chemistry, Crystallization, Entropy, Model studies, Statistical methods, Temperature effects.

A systematic study on the physical and chemical properties of finite water clusters as a function of size and on an infinite-sized cluster, i.e. ice, was performed by modeling a one-dimensional crystal. A modified version of a semi-empirical quantum chemical technique particularly well suited for hydrogen bonding was used. Calculations showed that hydrogen bonding leads to increased cluster stability with increasing size n at 0 K. Statistical mechanical methods were used to study cluster stability at finite temperatures as embodied in the free energy of formation. In contrast to the behavior of the 0 K binding energy, the free energy of formation is found to increase continually with cluster size. The 1-D clusters are therefore unstable and will not be found in nature. The quantum mechanical and statistical mechanical methods gave consistent results between the finite and infinite 1-D ice chains. (Geiger-PTT)
W91-00667

FIELD INVESTIGATIONS ON THE SNOW CHEMISTRY IN CENTRAL AND SOUTHERN CALIFORNIA-I. INORGANIC IONS AND HYDROGEN PEROXIDE.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W91-00842

FIELD INVESTIGATIONS ON THE SNOW CHEMISTRY IN CENTRAL AND SOUTHERN CALIFORNIA-II. CARBONYLS AND CARBOXYLIC ACIDS.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W91-00843

RELEASE OF HEAVY METALS FROM SNOWPACKS ON THE JAPAN SEA SIDE OF JAPAN.
Kanazawa Univ. (Japan). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W91-00858

MODELING SNOWFALL-TO-SNOWMELT DELAY.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
V. Yevjevich, and R. Sivapathasundram.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 203-211. 6 fig, 1 tab, 2 ref.

Descriptors: *Hydrologic models, *Mathematical models, *Model studies, *Runoff forecasting, *Snow accumulation, *Snowmelt, Catchment areas, Runoff volume, Stochastic process, Watersheds.

Precipitation is rarely divided into rainfall and snowfall. Snowfall delay until it becomes snowmelt, normally not modeled, needs modeling in order to accurately compute runoff from precipitation. From measured or computed snowfall and surveyed water content of snow on the ground the snowmelt as input to runoff can be determined both in the amount and time occurrence. For the total accumulated snowfall equal to the total accumulated snowmelt the difference of times of their occurrences gives the delayed snowfall-snowmelt time. Both delay and times of occurrences can then be statistically modeled. This modeling was undertaken on the W-3 watershed (3.25 sq mi) of the U.S. Agricultural Research Service Sleepers River watershed, near Danville, Vermont. The model is useful in its potential to determine the times when snowfall would be turned into snowmelt as an input to the runoff process. In the case where precipitation is simulated by the Monte Carlo method, then separated into rainfall and snowfall by the appropriate stochastic modeling, the models of snowfall delays would be a final step in transferring the precipitation input time series for runoff. (See also W91-00961) (Sand-PTT)
W91-00982

OPERATIONAL SNOW ACCUMULATION AND SNOWMELT MODELING.
National Board of Waters, Helsinki (Finland). Hydrological Office.
For primary bibliographic entry see Field 2B.
W91-00983

EXSRM, AN EXPERT SYSTEM FOR SNOWMELT RUNOFF MODEL (SRM).
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2E.
W91-01002

2D. Evaporation and Transpiration

EVALUATION OF THREE EVAPOTRANSPIRATION MODELS IN TERMS OF THEIR APPLICABILITY FOR AN ARID REGION.
Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.
R. Lemeur, and L. Zhang.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 395-411, May 1990. 11 fig, 4 tab, 19 ref.

Descriptors: *Arid-zone hydrology, *China, *Evapotranspiration, *Hydrologic models, *Model studies, Canopy, Electromagnetic waves, Hydrologic budget, River basins.

Evapotranspiration has a major controlling influence on all hydrological processes. Unfortunately, reliable estimates are extremely difficult to obtain, especially in arid regions. Three evapotranspiration models were evaluated: the Advection-Aridity, the Complementary Relationship Areal Evapotranspiration (CRAE), and the Penman-Monteith models. By applying these models to an arid river basin in Xinjiang, China, the consistency and reliability of the models were examined. It was found that the Penman-Monteith model is particularly sensitive to the canopy resistance, but is not sensitive to the surface albedo. In arid regions canopy resistance may range from 400 to 1000 s/m for crops and grassland and a 10% error in canopy resistance results in a 10% error in the estimated evapotranspiration. The use of the surface roughness length and surface albedo have significant effects on the estimates of evapotranspiration in the Advection-Aridity model. To estimate regional evapotranspiration, a weighted average method was proposed. By using this method, regional evapotranspiration is obtained from point estimates (Advection-Aridity and Penman-Monteith models) which are weighted according to their relative surface areas. The actual evapotranspiration for the river basin obtained by this method is very close to water balance estimates. It was concluded that the Advection-Aridity, the CRAE, and the Penman-Monteith models are applicable to arid regions, and that the Penman-Monteith model yields the best results. (Author's abstract)
W91-00165

ESTIMATES OF EVAPOTRANSPIRATION IN ALKALINE SCRUB AND MEADOW COMMUNITIES OF OWENS VALLEY, CALIFORNIA, USING THE BOWEN-RATIO, EDDY-CORRELATION, AND PENMAN-COMBINATION METHODS.
Geological Survey, Washington, DC.
L. F. W. Duell.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Supply Paper 2370-E, 1990. (Hydrology and Soil-Water-Plant Relations in Owens Valley, California; ch. E). 39p, 26 fig, 7 tab, 56 ref, append.

Descriptors: *Alkaline soils, *California, *Estimating equations, *Evapotranspiration, *Owens Valley, Bowen ratio, Eddy correlation, Meadows, Penman equation, Shrubs.

In Owens Valley, evapotranspiration (ET) is one of the largest components of outflow in the hydrologic budget and the least understood. ET estimates for December 1983 through October 1985 were made for seven representative locations selected on the basis of geohydrology and the characteristics of phreatophytic alkaline scrub and meadow communities. The Bowen-ratio, eddy-correlation, and Penman-combination methods were used to estimate ET. The results of the analyses appear satisfactory when compared with other estimates of ET. Results by the eddy-correlation method are for a direct and a residual latent-heat flux that is based on sensible-heat flux and energy-budget measurements. Penman-combination potential-ET estimates were determined to be unusable because they overestimated actual ET. Modification of the psychrometer constant of this method to account for differences between heat-diffusion resistance and vapor-diffusion resistance permitted actual ET to be estimated. The methods described in this report may be used for studies in similar semiarid and arid rangeland areas in the Western United States. Meteorological data for three field sites are included in the appendix of this report. Simple linear regression analysis indicates that ET estimates are correlated to air temperature, vapor-density deficit, and net radiation. Estimates of annual ET range from 301 millimeters at a low-

density scrub site to 1,137 millimeters at a high-density meadow site. The monthly percentage of annual ET was determined to be similar for all sites studied. (Author's abstract)
W91-00333

HAPEX-MOBILHY: RESULTS FROM A LARGE-SCALE FIELD EXPERIMENT.
Centre National de Recherches Meteorologiques, Toulouse (France).
For primary bibliographic entry see Field 7B.
W91-00456

FIRST ISLSCP FIELD EXPERIMENT: EXPERIMENT EXECUTION AND PRELIMINARY ANALYSES.
Maryland Univ., College Park.
For primary bibliographic entry see Field 7B.
W91-00460

RELATING NIMBUS-7 GHZ DATA TO LAND SURFACE EVAPORATION.
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
For primary bibliographic entry see Field 7B.
W91-00461

FIFE: THE VARIATION IN ENERGY PARTITION AT SURFACE FLUX SITES.
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
W. J. Shuttleworth.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 67-74, 9 fig, 4 ref.

Descriptors: *Evaporation, *Evapotranspiration, Climatology, Meteorology.

The proportion of surface energy used for evaporation was compared for 20 micrometeorological sites distributed over the First ISLSCP Field Experiment (FIFE) study area on four so-called 'Golden Days'. This proportion changed only slowly during daylight hours and the midday value represented the daylight average well. There were significant differences between sites, which are systematic but can change from day to day. Intersite differences on individual days showed no significant correlation with leaf area index or soil moisture, though there is evidence of a limited relation to the fraction of green vegetation. Site to site variation showed no obvious dependence on topography, but this result is confused by a possible relationship to experimental systems and method. Assuming the measurements are an unbiased, quasi-random sample, the spatial average evaporative fraction during daylight hours is satisfactorily defined within a standard error of around 2% to 3%. (See also W91-00454) (Author's abstract)
W91-00462

RELATIONSHIPS BETWEEN THE HYDROLOGIC BALANCE OF A SMALL WATERSHED AND REMOTELY SENSED SOIL MOISTURE.
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2A.
W91-00463

MONITORING SPATIAL VARIABILITY OF FOREST INTERCEPTION.
Montreal Univ. (Quebec). Dept. of Geography.
M. G. Durocher.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 215-229, July/September 1990. 7 fig, 2 tab, 43 ref.

Descriptors: *Data acquisition, *Forest hydrology, *Forest watersheds, *Hydrologic budget, *Instrumentation, *Interception, *Monitoring, *Rainfall-runoff relationships, *Spatial variation, *Statistical analysis, England, Groundwater movement, Model studies, Network design, Precipitation, Rainfall, Stemflow.

Most of the recent developments on forest interception are mainly concerned with only one of the two rainfall components affected by the interception: that lost by evaporation from the system. Little attention has been paid to the proportion of rainfall which actually reaches the ground. Many observations have helped to illustrate that the forest canopy is acting like a filter composed of a structure which can significantly modify the spatial distribution of the incident rainfall reaching the soil surface. Field instrumentation was designed and installed to quantify the influence of forest interception on the spatial and temporal distribution of water flux onto and into the forest soil at the plot scale. The field site is located near Bristol, England in a plantation of about 40-year-old red oak. An application is presented which demonstrates that the instrumentation has the required resolution to monitor the spatial variability and dynamics of the flux processes. The observations show that spatial variability of interception may play an important role, not only in small scale soil moisture heterogeneity, but also in the hydrological response of a forested catchment at the hillslope scale. Results also highlight the need for gathering more field information on the effects of vegetation on the spatial variability of soil surface water input. (Korn-PTT)
W91-00861

TRANSPIRATION OF PLANTATION PINUS RADIATA ESTIMATED BY THE HEAT PULSE METHOD AND THE BOWEN RATIO.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
T. J. Hatton, and R. A. Vertessey.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 289-298, July/September 1990. 5 fig, 1 tab, 40 ref.

Descriptors: *Bowen ratio, *Data acquisition, *Model studies, *Pine trees, *Transpiration, Australia, Catchment areas, Evaporation, Forest hydrology, Forest watersheds, Heat pulse method.

The direct measurement of water use by trees (transpiration) permits the partitioning of this component of total stand evaporation from soil evaporation and the loss of intercepted or condensed water from the canopy. Such estimates are necessary for modeling the biological, as distinct from the physical, control of transpiration with respect to evaporative demand, soil water levels, and canopy wetness. Water use by individual trees may be estimated by a number of plant physiological methods, including those based on sapflow tracer techniques such as the heat pulse method. The heat pulse technique can potentially provide accurate estimates of transpiration by individual plants. The heat pulse method was used to estimate stand transpiration from a radiata pine (Pinus radiata) plantation in southeastern Australia over a period of four days. The diurnal pattern of sapflow was related to net radiation with a time lag of about 1.5 hours. Despite high soil moisture levels, sapflow did not keep up with evaporative demand in the afternoon. Sapflow estimates of transpiration exceeded estimates for evaporation based on the micrometeorological measures of the Bowen ratio energy balance approach for all four days of the study. (Korn-PTT)
W91-00867

INTERCEPTION LOSS AND RAINFALL REDISTRIBUTION BY THREE SEMI-ARID GROWING SHRUBS IN NORTHEASTERN MEXICO.
Toronto Univ. (Ontario). Faculty of Forestry.
For primary bibliographic entry see Field 2I.
W91-00878

EVAPORATION FROM DAMPLAND VEGETATION ON A GROUNDWATER MOUND.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
P. Farrington, G. D. Watson, G. A. Bartle, and E. A. N. Greenwood.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 60-75, July 1990. 6 fig, 1 tab, 17 ref.

Descriptors: *Australia, *Evaporation, *Groundwater budget, *Groundwater depletion, *Vegetation effects, *Wetlands, Diurnal variation, Forest ecosystems, Mathematical analysis, Water measurement.

Evaporation by perennial vegetation growing above the unconfined aquifers represents the greatest discharge of the unconfined groundwater underlying Perth, Western Australia. Annual evaporation from an area of wetland vegetation in a dampland on a groundwater mound near Perth, Western Australia, was estimated from measurements of daily evaporation using ventilated chambers on thirteen occasions between March 1987 and March 1988. Evaporation over this period was estimated to be 814 mm, which exceeded the annual rainfall (747 mm) by 67 mm of water. Groundwater loss during summer was 266 mm of water (equivalent to 35% of annual rainfall). During summer, estimates of daily evaporation using diurnal water-table fluctuations gave values which were highly correlated ($r = 0.90$) with the ventilated chamber method. Provided that estimation was restricted to periods when vegetation is drawing mainly on groundwater, the diurnal fluctuation method offers a practical, cheap alternative method of estimating evaporation from wetlands. (Author's abstract)
W91-00879

DIURNAL FLUCTUATION IN STREAM FLOW AND IN SPECIFIC ELECTRIC CONDUCTANCE DURING DROUGHT PERIODS.
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
For primary bibliographic entry see Field 2E.
W91-00881

CHEMICAL STUDIES OF CHLORIDE AND STABLE OXYGEN ISOTOPES IN TWO CONIFER AFFORESTED AND MOORLAND SITES IN THE BRITISH UPLANDS.
Institute of Hydrology, Wallingford (England).
C. Neal, and P. T. W. Rosier.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 269-283, July 1990. 5 fig, 2 tab, 28 ref.

Descriptors: *Chlorides, *Coniferous forests, *Forest hydrology, *Forest watersheds, *Oxygen isotopes, *Rainfall-runoff relationships, *Scotland, *Tracers, *Water chemistry, Chemical properties, Network design, Rainfall, Seasonal variation, Stream discharge, Surface water data, Wales, Water sampling.

Chloride concentration variations for three streams in the Crinan Canal region of southwest Scotland, draining heather (Calluna vulgaris) and immature and mature sitka spruce conifer forest (Picea sitchensis (Bong.) Carr) are compared with incident rainfall values. Results show the importance, and correspondence, of in-catchment processes for attenuating atmospheric inputs of chloride before its entry to the stream. All three streams exhibit a damped chloride concentration variation compared with rainfall. The chloride chemistries for the three streams are intercorrelated. The weekly data show a net accumulation of chloride into the catchment over the 1 year sampling period. This is associated with an inappropriate stream sampling frequency and/or large yearly fluctuations, in the rainfall input; 80% of the rainfall chloride contribution was introduced during four of the 52 weeks of sampling. The yearly flux of chloride leaving the catchment as stream flow is remarkably similar for all three catchments. The study highlights the need for long and detailed data records from which information can be obtained on chemical budgets and the deficiencies in the measurement of atmospheric inputs of chloride. Although mature conifers are known to capture significant inputs of chemicals to a catchment, not measured by a standard rainfall collector in uplands areas, analogous results are not inferred in the lowland Crinal Canal case. Far more detailed studies are required if a definitive statement is to be made. The chloride results from the Crinan Canal Study are compared with analogous data for streams draining the Hafren Forest at Plynlimon in mid-Wales. Similar degrees of damping are observed and seasonal oscillations occur which do not have the same

phase or amplitude. In addition, oxygen isotopic data are presented for the Plynlimon case to highlight a higher degree of damping than for chloride. (Author's abstract)
W91-00890

EVAPORATION FROM SOIL SURFACE IN PRESENCE OF SHALLOW WATER TABLES.
Mosul Univ. (Iraq). Dept. of Irrigation and Drainage.
H. R. Rasheed, H. Al-Anaz, and K. A. Abid.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 353-361. 4 fig, 3 tab, 8 ref.

Descriptors: *Evaporation, *Soil water, *Water table, Capillarity, Field tests, Soil surfaces.

Field experiments were carried out to study the effect of the presence of shallow water table depth on the evaporation process from soil surfaces. Four different soils were obtained from known agricultural sites near Mosul, Iraq, for investigations with the water table at six different depths from 175 to 50 cm. There are two main factors affecting the evaporation process: the external meteorological conditions and/or the soil characteristics. These factors affect the soil surface evaporation individually or collectively depending on water table location and capillary rise height of the soil. Based on the experimental work, equations for estimating the soil surface evaporation were determined for relatively deep and shallow water table depths. (See also W91-00961) (Author's abstract)
W91-00996

2E. Streamflow and Runoff

POPULATIONS, GROWTH, BIOMASS AND PRODUCTION OF FISH IN A SMALL STREAM IN NORTH-WEST POLAND.
Miljoestyrelsen, Silkeborg (Denmark). Freshwater Lab.
For primary bibliographic entry see Field 2H.
W91-00007

STREAM CANOPY AND ITS RELATIONSHIP TO SALMONID BIOMASS IN THE INTERMOUNTAIN WEST.
Forest Service, Ogden, UT. Intermountain Research Station.
For primary bibliographic entry see Field 8I.
W91-00013

TESTING OF HABITAT ASSESSMENT MODELS FOR SMALL TROUT STREAMS IN THE MEDICINE BOW NATIONAL FOREST, WYOMING.
Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie.
For primary bibliographic entry see Field 8I.
W91-00014

ALGORITHM FOR ROUTING UNSTEADY FLOWS IN URBAN DRAINAGE NETWORKS.
Gutteridge, Haskins and Davey Pty Ltd., Sydney (Australia).
For primary bibliographic entry see Field 4C.
W91-00031

DEPTH-INTEGRATED MODEL FOR SUSPENDED SEDIMENT TRANSPORT.
Technische Hogeschool Delft (Netherlands).
For primary bibliographic entry see Field 2J.
W91-00033

HYDRAULIC JUMPS AT POSITIVE AND NEGATIVE STEPS.
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
For primary bibliographic entry see Field 8B.
W91-00034

VELOCITY DISTRIBUTION IN ALLUVIAL CHANNEL FLOW.
Karnataka Regional Engineering Coll., Suratkal (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00036

FLOW RESISTANCE IN COMPOUND CHANNELS.
Ulster Univ. at Jordanstown, Newtownabbey (Northern Ireland). Dept. of Civil Engineering and Transport.
W. R. Myers, and E. K. Brennan.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 2, p 141-155, 1990. 11 fig, 30 ref.

Descriptors: *Channel morphology, *Discharge capacity, *Flood channels, *Flow discharge, *Flow resistance, Channel flow, Flood plains, Hydraulic models, Hydraulics, Momentum transfer.

Preliminary results from the Flood Channel Facility sponsored by the British Science and Engineering Research Council and Hydraulics Research Ltd. are presented. The Facility takes the form of a large compound channel and the first series of experiments have been analyzed to assess flow resistance characteristics of simple and compound channels having smooth boundaries. The effects of momentum transfer from main channel to flood plains on the capacity of the compound and main channel sections have been demonstrated. Flow resistance relationships for the compound section, main channel and flood plains have been presented in terms of Manning's and Darcy-Weisbach resistance coefficients, and compared with simple channel shapes. This has emphasised the complexity of compound channel flow resistance, while also pointing out the likely errors involved in applying simple channel methods of analysis and design to rivers and channels of compound geometry. (Author's abstract)
W91-00037

IMPROVED METHOD OF CALCULATION FOR STEADY UNIFORM FLOW IN PRISMATIC MAIN CHANNEL/FLOOD PLAIN SECTIONS.
Queen Mary Coll., London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00038

TURBULENCE MEASUREMENTS IN A SHEAR LAYER REGION OF A COMPOUND CHANNEL.
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00039

SERC FLOOD CHANNEL FACILITY: SKEWED FLOW EXPERIMENTS.
Bristol Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00040

WAVE TYPE FLOW AT ABRUPT DROPS.
Hirosaki Univ. (Japan). Faculty of Agriculture.
N. Kawagoshi, and W. H. Hager.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 2, p 235-252, 1990. 14 fig, 7 ref, append.

Descriptors: *Flow characteristics, *Hydraulic geometry, *Hydraulic jump, *Hydraulics, *Standing waves, Cavitation, Channel flow, Fluid mechanics, Froude number, Tailwater, Wave crest.

The wave-type flow over abrupt drops was investigated experimentally. Based on a large number of observations collected in a 50-cm-wide channel with two different drop heights, and on the analysis of this and other data, the following conclusions may be drawn: (1) The ratio of sequent depths for wave-type flow may explicitly be expressed as the sum of the sequent depths ratio for a classical jump and the sequent depth ratio excess. The sequent depth ratio excess is proportional to the inflow Froude number. (2) For relative drops of less than the limiting height the tailwater surface becomes undular. (3) Quantities of interest, such as the coordinates of the wave crest, the plunge point, the lengths of the standing wave and jump, or the length of bottom separation may be given by two scaling parameters. These are the drop Froude number and the modified approaching velocity head. (4) A dimensionless plot allows direct reading of all flow-geometry parameters of interest in wave-type flow. (5) The data compare reasonably well with other experiments, but they include a much wider range of inflow parameters. This range of parameters accounts for all cases encountered in real applications. (Stoehr-PTT)
W91-00042

GEOMORPHOLOGICAL EFFECTS OF CATASTROPHIC FLOODING ON A SMALL SUBTROPICAL ESTUARY.
Council for Scientific and Industrial Research, Congella (South Africa). Estuaries and Coastal Processes Programme.
For primary bibliographic entry see Field 2J.
W91-00049

EXPERIMENTAL STUDY OF COMPLEX RESPONSE IN RIVER CHANNEL ADJUSTMENT DOWNSTREAM FROM A RESERVOIR.
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 2J.
W91-00050

BED FORM RESISTANCES IN OPEN CHANNEL FLOWS.
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00063

PREDICTION OF FLOW CHARACTERISTICS IN MAIN CHANNEL/FLOOD PLAIN FLOWS.
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00073

ESTIMATING STATISTICAL PARAMETERS FOR AN N-SEGMENT DISCRETE HYDROLOGIC DATA SERIES.
Clark Univ., Worcester, MA. Dept. of Geography.
W. Du.
Journal of Hydrology (New Zealand) JLHYAD, Vol. 28, No. 1, p 3-16, 1989. 1 fig, 1 tab, 32 ref.

Descriptors: *Flood data, *Flood discharge, *Flood forecasting, *Flood frequency, *Floods, *Statistical methods, China, Parametric hydrology, Probability distribution, Probable maximum flood.

Extreme or rare floods, with probabilities in the range of 1 in 100 to 1 in 10 million chance of occurrence per year, are of interest to the hydrologic and engineering communities for project design and planning. However, streamflow records of greater than 100 yr are meager, and most records are considerably shorter. In the United States and other countries, the Pearson Type III and the Log-Pearson Type III probability distributions are recommended by governmental water resources agencies for flood frequency analysis. The accuracy of such analysis directly depends on the accuracy of estimating parameters of those distributions. A new algorithm to estimate statistical parameters for an N-segment discrete hydrological data series and related conditional flood frequency analysis has been developed. The new algorithm differs from traditional methods in two ways: (1) the method concerns an N-segment discrete hydrologic data series, and its mathematical treatment of extreme floods more closely approximates real hydrological situations than traditional methods, and (2) the method deals with conditional frequencies and considers the real position of historical floods. Application of the algorithm to a

dataset from a river basin in China provided a good fit. (Tappert-PTT)
W91-00074

WATER BALANCE OF LAKE ROTOITI, NORTH ISLAND: FLOODS AND SHORT-CIRCUITING OF INFLOWS FROM LAKE ROTORUA.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W91-00077

RECONSTRUCTION OF THE RECENT FLOW HISTORY OF A BRAIDED GRAVEL RIVER.
Canterbury Univ., Christchurch (New Zealand). Dept. of Geography.
T. B. Hoey.
Journal of Hydrology (New Zealand) JLHYAD, Vol. 28, No. 1, p 76-97, 1989. 10 fig, 3 tab, 44 ref.

Descriptors: *Bed load, *Braided streams, *Channel morphology, *Mannings equation, *Mathematical models, *Sediment transport, *Streamflow, Channel flow, New Zealand, Paleohydrology, River beds, Sedimentation.

Coarse gravel deposits have commonly been used in paleohydrologic reconstruction, and are divided into the hydraulic approach and the geomorphic approach. The hydraulic approach was used to reconstruct recent flows in the Kowai River, a braided gravel-bed river near Springfield, New Zealand. Critical tractive stress, the method used, is sensitive to selection of the dimensionless shear stress at which entrainment is presumed to occur, and to variation in the measured parameters of slope and particle size. The importance of cluster bedforms in the Kowai leads to the choice of 0.06 for the critical dimensionless shear stress. Five cross-sections were used for paleodischarge analysis. Flood magnitudes that correspond well with the two year flood of the river were obtained using a technique of reconstructing the river bed at the time of deposition of the various bar units. Combination of discharge estimates with geomorphic evidence permitted interpretation of current river bed morphology in terms of three recent flow events. Sources of uncertainty include measurement error in slope, particle size and cross-section surveys, reliability of roughness determination, estimation of suspended sediment concentration, accuracy of estimates of the effect of bar roughness, applicability of shear stress equations to turbulent conditions, and accuracy of bed surface reconstructions. (Tappert-PTT)
W91-00079

HYDROLOGIC AND HYDRAULIC RESEARCH IN MOUNTAIN RIVERS.
Geological Survey, Denver, CO.
R. D. Jarrett.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 419-429, June 1990. 6 fig, 1 tab, 29 ref.

Descriptors: *Alpine regions, *Flood flow, *Hydraulics, *Mountain streams, *Paleohydrology, *Rainfall-runoff relationships, Colorado, Data acquisition, Data interpretation, Elevation, Error analysis, Flood peak, Rocky Mountains, Storms.

Although current (1990) knowledge of hydrologic and hydraulic processes is based on many years of study, there are river environments where these processes are complex and poorly understood. One of these environments is in mountainous areas, which cover about 25% of the United States. Use of conventional hydrologic and hydraulic techniques in mountain-river environments may produce erroneous results and interpretations in a wide spectrum of water resources investigations. An ongoing U.S. Geological Survey research project is being conducted to improve the understanding of hydrologic and hydraulic processes of mountainous areas and to improve paleohydrologic techniques used in mountain rivers. Much of this research has been conducted in Colorado but rivers in other Rocky Mountain states are also being studied. To understand runoff from mountainous areas, the causative hydrologic processes, particularly precipitation, need to be understood. Floods of interest are produced by short-duration and high-duration intensity rainstorms. An elevation limit (2,450 m) has been observed for significant rainfall which supports the elevation limit of significant flood runoff from studies of streamflow data and paleoflood investigations. Knowledge of data errors, problems with application of measurement techniques, and overestimated peak discharge is essential because the values of the largest floods commonly are the most erroneous. (Peters-PTT)
W91-00083

HYDROCLIMATIC APPLICATION STRATEGY FOR THE POISSON PARTIAL DURATION MODEL.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
J. F. Cruise, and K. Arora.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 431-442, June 1990. 1 fig, 7 tab, 42 ref. Louisiana Water Resources Research Institute Project No. 127-90-5141.

Descriptors: *Duration analysis, *Flood forecasting, *Louisiana, *Model studies, *Poisson ratio, *Statistical analysis, Climatic data, Drainage area, Humid climates, Streamflow data, Subtropic zone.

A strategy for formulating and testing the Poisson partial duration extreme value model was developed. The procedure was demonstrated using recorded streamflow series from a humid subtropical region of the southern United States. The observed data series were partitioned by climatic causes and tested for both the Poisson assumption and the validity of the exponential as marginal distributions. Several statistical tests were utilized in making these determinations. It was found that a majority of streamflow series (15 of 19 watersheds in Louisiana) could be represented by the model and that significant differences do exist between the arrival structures of floods resulting from different climatic mechanisms. However, these differences generally do not exist in the distribution of the flood magnitudes. In addition, it is possible that model validity is restricted by drainage basin size. The largest drainage areas were consistently found to be not well represented by the Poisson approach. It is possible that the storage effects and nonuniformity of large watersheds may damp out the Poisson characteristics of the flood series. (Author's abstract)
W91-00084

ERRORS IN ESTIMATED STREAMFLOW PARAMETERS AND STORAGES FOR UNGAUGED CATCHMENTS.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
K. C. Gan, T. A. McMahon, and I. C. O'Neill.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 443-450, June 1990. 2 fig, 7 tab, 11 ref.

Descriptors: *Error analysis, *Model studies, *Rainfall-runoff relationships, Reservoi, *Storage requirements, *Streamflow, *Streamflow forecasting, *Ungaged catchments, Australia, Flood control, Regression analysis, Reservoir storage, Statistical analysis.

For a set of 81 catchments in southeast Victoria, Australia, predictive equations were developed by least squares regression of the mean and coefficient of variation of annual streamflow against a variety of rainfall and physiographic parameters. The data were also divided into subsets according to catchment size, subregion, or record length if the relationships differed significantly between subsets. Only the catchment area and some rainfall statistical parameters were found to be significant. Streamflow parameters predicted by the regression equations were used to estimate storage requirements in ungaged catchments. The errors in estimating streamflow parameters by regression for a particular ungaged catchment are unknown, but may be estimated on an average statistical basis. The likely upper boundary to the storage error may be estimated and due allowance made in the design of reservoirs for ungaged catchments. (Peters-PTT)
W91-00085

STORMFLOW AND SEDIMENT LOSS FROM INTENSIVELY MANAGED FOREST WATERSHEDS IN EAST TEXAS.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 4C.
W91-00087

TEMPORAL LAG EFFECT IN BED LOAD SEDIMENT TRANSPORT.
Willing and Partners, Canberra (Australia).
For primary bibliographic entry see Field 2J.
W91-00093

INFLUENCE OF SAND OR GRAVEL ON THE EROSION OF COHESIVE SEDIMENT.
Queen's Univ., Kingston (Ontario).
For primary bibliographic entry see Field 2J.
W91-00095

WEAKLY DEPOSITING TURBIDITY CURRENT ON A SMALL SLOPE.
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
For primary bibliographic entry see Field 2J.
W91-00096

MEASURES OF FLOW VARIABILITY FOR GREAT LAKES TRIBUTARIES.
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
R. P. Richards.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 361-377, November 1989. 6 fig, 2 tab, 8 ref.

Descriptors: *Flow profiles, *Monitoring, *Statistical analysis, *Stream discharge, *Stream pollution, *Streamflow data, *Water quality, Great Lakes, Mathematical analysis, Nonpoint pollution sources, Pollution load.

Design of monitoring programs for load estimation is often hampered by the lack of existing chemical data from which to determine patterns of flux variance, which determine the sampling program requirements when loads are to be calculated using flux-dependent models like the Beale Ratio Estimator. In contrast, detailed flow data are generally available for the important tributaries. For pollutants from nonpoint sources there is often a correlation between flow and pollutant flux. Thus, measures of flow variability might be calibrated to flux variability for well-known watersheds, after which flow variability could be used as a proxy for flux variability when estimating sampling needs for tributaries for which adequate chemical observations are lacking. Three types of measures of flow variability were investigated, including ratio measures, spread measures, and the coefficient of variation of the logs of flows. In the latter, flows are log transformed because flow distributions are often approximately log-normal. The ratio measures and the spread measures are scale independent, and thus are measures only of the shape of the distribution. The coefficient of variation is also scale independent but in log space. Values of these measures of flow variability for 120 Great Lakes tributaries are highly intercorrelated, although the relationship is often non-linear. The coefficient of variation of the log of the flows is also well correlated with the coefficient of variation of fluxes of suspended solids, total phosphorus, and chloride, for a smaller set of rivers where the existence of abundant chemical data allows comparison. Tributaries with abnormal distributions often show up as outliers when one measure of flow variability is plotted against another. (Author's abstract)
W91-00136

MENU OF COUPLED VELOCITY AND SEDIMENT-DISCHARGE RELATIONS FOR RIVERS.
Pima County Dept. of Transportation and Flood Control, Tucson, AZ.

For primary bibliographic entry see Field 2J.
W91-00149

STABILITY LIMITS FOR PREISSMANN'S SCHEME.
Hydraulics Research Ltd., Wallingford (England).
P. G. Samuels, and C. P. Skeels.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 8, p 997-1012, August 1990. 4 fig, 25 ref, 2 append.

Descriptors: *Channel morphology, *Flow models, *Model studies, *Open-channel flow, *River flow, Flow discharge, Flow equations, Flow velocity, Fourier analysis, Hydraulic engineering, Numerical analysis, Stability analysis, Water level.

Computational models of river flow are a well-established tool in engineering practice. Models based on the St. Venant equations of open-channel flow can provide quantitative information on discharge, velocity, and level for a variety of purposes. The St. Venant equations form the basis of many one-dimensional river models. The Preissmann box scheme is often used to generate approximate solutions, chiefly because the modeler has considerable flexibility in the choice of space and time steps. A comprehensive Fourier stability analysis of the Preissmann scheme was applied to the St. Venant equations, including the general form of the friction term. Previous analyses have either neglected or simplified the form of the flow resistance. No such approximations are made in this application. It shows analytically that the linearized, numerical equations are stable when weighted towards the new time level and when the magnitude of the Vedernikov number is less than one. This second condition is the limit of hydrodynamic stability at which roll waves form and the numerical scheme mirrors this physical stability limit. Difficulties that occur in practical applications of this computational method must have their origin in factors omitted from the Fourier analysis, such as the treatment of boundary conditions and the nonlinear terms in the flow equations. (Author's abstract)
W91-00150

EXPLICIT METHODS FOR 2-D TRANSIENT FREE-SURFACE FLOWS.
Florida International Univ., Miami. Dept. of Civil and Environmental Engineering.
R. J. Fennema, and M. H. Chaudhry.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 8, p 1013-1034, August 1990. 14 fig, 21 ref.

Descriptors: *Finite difference methods, *Flow models, *Hydraulic engineering, *Model studies, *Numerical analysis, *Open-channel flow, *Streamflow, Boundary conditions, Critical flow, Flood waves, Unsteady flow, Viscosity.

The computation of unsteady free-surface flows is required for the analysis of tidal oscillations, flows produced by the operation of control structures, and flood waves generated by storms or failure of structures. For such analyses, numerical models may be used as a management tool if the water level and wave speed can be accurately predicted over a wide range of conditions. In many situations these flows are described by two-dimensional models, which require solver routines and the inclusion of proper boundary conditions. Two second-order accurate finite-difference explicit schemes were applied to integrate the shallow-water (St. Venant) equations describing two-dimensional, unsteady gradually varied flows. Both schemes are second-order accurate in space and time, allow sharp discontinuous initial conditions, and do not require isolation of the bores. Both subcritical and supercritical flows may be present simultaneously in different parts of the channel or in a sequence in time. These schemes were applied to analyze two typical hydraulic flow problems: partial dam breach and passage of a flood wave through a channel contraction. It was found that some numerical oscillations occur near the sharp-fronted waves; these can be controlled by the selective addition of artificial viscosity. Boundary conditions are readily incorporated in both schemes, but the finite-difference formulation of sharp corners needs additional investigation. Explicit tracking of the bore is not necessary in these schemes, since the shock is spread only over a few mesh points. Although many schemes are available for computational analysis, these schemes are relatively easy to program and give good results. (Fish-PTT)
W91-00151

NONPARAMETRIC FLOOD-FREQUENCY ANALYSIS WITH HISTORICAL INFORMATION.
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
K. Adamowski, and W. Feluch.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 8, p 1035-1047, August 1990. 6 fig, 15 ref. National Science and Engineering Research Council of Canada.

Descriptors: *Flood data, *Flood forecasting, *Flood frequency, *Historic floods, *Simulation analysis, Parameter estimation, Parametric hydrology, Probability distribution.

Inclusion of historical information in flood-frequency analysis increases the accuracy of flood estimates; however, some of the major factors affecting this accuracy are the a-priori specification of a particular probability distribution function and the method of estimating its parameters. A new nonparametric procedure is proposed that altogether eliminates the specification of a distribution and greatly simplifies parameter-estimation problems. The nonparametric method, however, is not particularly efficient in extrapolating distribution function beyond an available record length. Thus, to overcome such a problem, a new kernel is introduced in the form of an extreme-value distribution. Also, the smoothing parameter is estimated by a cross-validation procedure, and a new mixture-distribution model is proposed for inclusion of historical data into analysis. A simulation study employing a two-parameter log-normal distribution shows that the accuracy of flood estimates does not greatly increase with the addition of data length beyond 10 years. It was found that inclusion of historical information into nonparametric analysis improves extrapolation. (Author's abstract)
W91-00152

MODEL OF FLOW IN REGULATED OPEN-CHANNEL NETWORKS.
Miami Univ., Coral Gables, FL. Coll. of Engineering.
E. D. Swain, and D. A. Chin.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 537-556, July/August 1990. 10 fig, 13 ref.

Descriptors: *Drainage engineering, *Hydraulic engineering, *Model studies, *Numerical analysis, *Open-channel flow, *Unsteady flow, Drainage patterns, Flow profiles, Hydraulic structures, Leakage, Mathematical equations, Mathematical models, Mathematical studies, Open channels, Open-channel drainage, Simulation analysis.

The use of computers to model unsteady flow in open channels is an essential part of water resources engineering. A numerical model was developed to simulate unsteady flow in open-channel networks. The model is an improvement over currently available network models in that the effects of hydraulic structures and leakage through the riverbed are incorporated. In addition, a matrix solution method was developed that takes advantage of the banded nature of network problems and, in some cases, reduces the solution time drastically. A method of reducing the bandwidth of the coefficient matrix is incorporated. Verification by comparison to other solution methods shows close agreement. The computation time using the banded matrix solution routine was compared to a commonly used method for reducing solution time to determine the conditions under which the banded matrix solution is faster. The model presented is useful in simulating gate operating rules, analyzing effective flood control measures, and comparing water delivery schemes over large distances where there is significant loss to leakage. (Author's abstract)
W91-00172

STREAMFLOW SIMULATION USING DETERMINISTIC MODEL.
Dames and Moore, Park Ridge, IL.
A. Prakash, and G. Dearth.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 566-580, July/August 1990. 2 fig, 8 tab, 15 ref.

Descriptors: *Model studies, *Streamflow forecasting, *Wastewater disposal, *Water pollution control, California, Computer models, Correlation analysis, Data interpretation, Distribution patterns, Evapotranspiration, Hydrologic data, Meteorological data collection, Regression analysis, Streamflow data, Time series analysis.

To protect human health and the natural environment, most regulatory agencies require dischargers to identify the hydrologic characteristics of the receiving stream and establish a relationship between streamflow and quality and quantity of effluents to be discharged. To develop this information for ungaged streams, the hydrologist has to be able to simulate sequential daily, monthly, and seasonal streamflows for different climatic conditions. The National Weather Service River Forecast System model was used to generate 30 years of sequential streamflows for Laguna de Santa Rosa in northern California. The model was calibrated by simulating 11 years of daily streamflows for a 12.5 sq mi subwatershed in the upper portion of the watershed. Daily streamflow data for this subwatershed were retrieved from a USGS gaging station. Daily precipitation values were obtained as weighted averages of data from two stations in the vicinity. These were converted into a six-hourly time series using average distribution patterns for six-hourly precipitation. Daily lake evaporation values were estimated using regression analyses with monthly pan evaporation data for nearby stations, daily average distribution patterns, and applicable pan coefficients. These values were converted into evapotranspiration demand by the model using specified evapotranspiration adjustment factors. In spite of these approximations and adjustments, the calibration was satisfactory. However, extreme caution must be exercised to generate representative input data for these models using appropriate regression, correlation, and data generation techniques. (Fish-PTT)
W91-00174

RAINFALL-REAERATION EFFECTS.
Florida Inst. of Tech., Melbourne. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 2A.
W91-00175

REGIONAL FLOW-DURATION CURVES FOR UNGAUGED SITES IN MASSACHUSETTS.
Massachusetts Div. of Water Supply, Boston.
N. Fennessey, and R. M. Vogel.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 530-549, July/August 1990. 4 fig, 2 tab, 33 ref, append.

Descriptors: *Flow duration, *Flow models, *Hydrologic models, *Massachusetts, *Model studies, *Streamflow forecasting, *Watershed management, Algorithms, Basins, Distribution graphs, Probability distribution, Regression analysis.

A flow-duration curve is the cumulative distribution function of daily streamflows at a site. A regional hydrologic model was developed for estimating flow-duration curves at ungaged and unregulated basins in Massachusetts. Flow-duration curves often exhibit complex shapes, requiring probability density functions with three or more parameters. The lower half of daily flow-duration curves were approximated using a two-parameter lognormal probability density function. A conjugate gradient algorithm was employed to fit lognormal density functions to the lower half of ob-

served flow-duration curves at 23 basins. Regional regression equations were developed to describe the lognormal model parameters in terms of easily measured basin characteristics. The resulting regional flow-duration model only requires estimates of the watershed area, and a basin relief parameter, both of which are easily obtained from U.S. Geological Survey 7.5-min quadrangle maps. In addition, confidence intervals were derived for flow-duration curves estimated at ungaged sites. A validation experiment revealed that the resulting regional hydrologic model can provide remarkably precise estimates of a flow-duration curve at an ungaged site, considering the simplicity of the model and its ease of application. (Author's abstract)
W91-00185

ANALYSIS OF INSTANTANEOUS RAINFALL RATE DURING FLASH FLOODS IN BARCELONA.
Barcelona Univ. (Spain). Dept. of Atmospheric Physics, Astronomy and Astrophysics.
For primary bibliographic entry see Field 2B.
W91-00189

COST EFFECTIVENESS OF THE STREAMFLOW-GAGING PROGRAM IN WEST VIRGINIA.
Geological Survey, Charleston, WV.
G. S. Runner, R. L. Bragg, and J. T. Atkins.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 87-4089, 1989. 57p, 12 fig, 17 tab, 20 ref.

Descriptors: *Cost analysis, *Data acquisition, *Flow measurement, *Hydrologic data, *Stream gages, *Streamflow, *Water resources data, *West Virginia, Budgeting, Estimating, Funding, Gaging stations, Streamflow data.

This report documents the results of a cost-effectiveness study of streamflow-gaging activities in West Virginia. Data uses and sources of funding were identified for 74 streamflow-gaging stations currently operated in West Virginia. One streamflow-gaging was identified as producing data no longer sufficiently needed to warrant continuing its operation; this station was discontinued. Data collected at three other streamflow-gaging stations were identified as having uses specific only to short-term studies; it was recommended that these stations be discontinued at the end of the data-collection phases of the studies. The current policy for operation of the 74 streamflow gaging stations required a budget of $390,000 per year. The average standard error of estimation of streamflow records is 24.6% and the range of error at individual stations is from 6.6 to 79.2%. It was shown that this overall standard error could be reduced to 22.0% if field activities were altered with no change in budget. A minimum budget of $375,000 is required to operate the 74 stations; a smaller budget would not permit proper service and maintenance of the stations and recorders. At the minimum budget, the average standard error is 22.5%. The maximum budget analyzed was $430,000, which resulted in an average standard error of 21.1%. Large areas in West Virginia lack sufficient streamflow data to provide valid estimates of streamflow characteristics. The paucity of data in these areas will be remedied as funds become available. (Author's abstract)
W91-00331

GUIDE FOR SELECTING MANNING'S ROUGHNESS COEFFICIENTS FOR NATURAL CHANNELS AND FLOOD PLAINS.
Geological Survey, Denver, CO.
G. J. Arcement, and V. R. Schneider.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Supply Paper 2339, 1989. 38p, 22 fig, 4 tab, 23 ref.

Descriptors: *Channel flow, *Channel morphology, *Flood plains, *Hydraulic roughness, *Mannings equation, *Roughness coefficient, *Vegetation effects, Photography, Riparian vegetation, Shrubs, Trees.

Although much research has been done on Manning's roughness coefficient, n, for stream channels, very little has been done concerning the roughness values for densely vegetated flood plains. The n value is determined from the values of the factors that affect the roughness of channels and flood plains. In densely vegetated flood plains, the major roughness is caused by trees, vines, and brush. The n value for this type of flood plain can be determined by measuring the vegetation density of the flood plain. Photographs of flood-plain segments where n values have been verified can be used as a comparison standard to aid in assigning n values to similar flood plains. (Author's abstract)
W91-00335

COMPARISON OF TRACER-DILUTION AND CURRENT-METER DISCHARGE MEASUREMENTS IN A SMALL GRAVEL-BED STREAM, LITTLE LOST MAN CREEK, CALIFORNIA.
Geological Survey, Menlo Park, CA. Water Resources Div.
G. W. Zellweger, R. J. Avanzino, and K. E. Bencala.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4150, 1989. 20p, 7 fig, 13 ref.

Descriptors: *California, *Current meters, *Discharge measurement, *Dye releases, *Streamflow, *Tracers, Gravel, Stream discharge, Streambeds, Underflow.

Discharge was determined in a small gravel-bed stream, Little Lost Man Creek, California, using both a current meter and two tracer dilution measurements: one with a mixing length of 25 meters and the other with a mixing length of 300 meters. Comparison of discharge values obtained indicated that as much as 25% of the channel discharge may have been flowing as underflow through gravel zones in the channel. Current-meter discharge measurements were used to obtain point discharge; tracer-dilution discharge measurements were used to obtain discharge measurements which incorporated mixing of surface water and underflow over 25 and 300 meters of stream reach. Within the study reach, the confined channel contained gravel and cobble to a depth of at least one meter. During summer low flow of 5 to 20 L/s, the surface stream appeared to be 1 to 2 meters wide, about 20% of the channel width. Determining discharge in small pool-and-riffle streams using conventional current-meter techniques is hampered by shallow depths, rough bottoms, and flow through the gravel bed under and parallel to the stream. Furthermore, discharge can vary both diurnally and longitudinally over relatively short reaches. Discharge measurement by continuous tracer dilution can accommodate these factors to some extent. Chloride was injected for eight days during which the stream water was sampled along a 300-meter reach below the injection point. On the seventh day, a second injection of sodium, chloride, and rhodamine WT dye was made for 24 hours, 305 meters below the first injection, and was sampled 25 meters downstream. Current-meter discharge measurements were made along the study reach three times during the experimental period. The average discharge of 17.4 L/s calculated from the tracer that traveled 300 meters was greater than the average of 15.9 L/s calculated for the tracer that traveled 25 meters. Both of these tracer-dilution measurements were greater than the average current-meter discharge measurement of 13.0 L/s. The comparison supports the hypothesis that a significant part of total stream discharge is moving as underflow through gravel zones within the stream channel. (Author's abstract)
W91-00337

STORM RUNOFF AND ITS EFFECTS ON THE WATER QUALITY AND BOTTOM-MATERIAL QUALITY OF CEDAR CREEK, WEST-CENTRAL ILLINOIS, 1985-6.
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-00339

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1987 - NOVEMBER 30, 1988.
Geological Survey, Reston, VA.
S. P. Sauer, W. E. Harkness, B. E. Krejmas, and K. E. White.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 89-585, 1989. 84p, 7 fig, 1 plate, 20 tab.

Descriptors: *Annual reports, *Delaware River, *Diversion, *Interbasin transfers, *Reservoir releases, New Jersey, New York City, Precipitation, Reservoir storage, Runoff.

A Decree of the Supreme Court of the United States in 1954 established the position of Delaware River Master. The Decree authorizes diversions of water from the Delaware River basin but requires compensating releases from certain New-York-City-owned reservoirs to be made under the supervision and direction of the River Master. Reports to the Court, not less frequently than annually, were stipulated. During the 1988 report year, December 1, 1987, to November 30, 1988, precipitation and runoff ranged from above average to below average in the Delaware River basin. For the year as a whole, precipitation was 6.41 inches below average. Reservoir storage in the basin remained in the normal zone of the operation curves for the reservoirs throughout the year and operations were conducted as prescribed by the Decree for the entire report year. On December 1, 1987, combined storage in New York City Delaware River Basin reservoirs was 86 percent of capacity. During the winter and spring, storage increased to capacity by the beginning of the water operations year, June 1, 1988. Diversions from the Delaware River basin by New York City and New Jersey did not exceed those authorized by the terms of the Amended Decree. Releases were made as directed by the River Master at rates designed to meet the Montague flow objective on 127 days during the year. Releases were made at augmented conservation rates or at rates designed to relieve thermal stress in the streams downstream from the reservoirs at other times. The excess release quantity as defined by the Decree was expended on October 28, 1988 and the Montague design rate was reduced from 1,860 cu ft/s to 1,750 cu ft/s. New York City complied fully with the terms of the Decree and with the directives of the River Master during the year. (Author's abstract)
W91-00344

STREAMFLOW AND WATER-QUALITY DATA FOR LITTLE SCRUBGRASS CREEK BASIN, VENANGO AND BUTLER COUNTIES, PENNSYLVANIA, DECEMBER 1987 - NOVEMBER 1988.
Geological Survey, Harrisburg, PA.
K. M. Kostelnik, and R. R. Durlin.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Rpt. 89-577, 1989. 26p, 4 fig, 14 tab, 14 ref. Prepared in cooperation with the US Dept. of the Interior, Office of Surface Mining Reclamation and Enforcement and the PA. Dept. of Environmental Resources, Bureau of Mining and Reclamation

Descriptors: *Pennsylvania, *Streamflow data, *Surface water, *Water quality, Ions, Little Scrubgrass Creek Basin, Metals, Nutrients, Suspended sediments.

Streamflow and water-quality data were collected throughout the Little Scrubgrass Creek basin, Venango and Butler Counties, Pennsylvania, from December 1987 to November 1988, to determine the prevailing quality of surface water throughout the basin. This data will assist the Pennsylvania Department of Environmental Resources during its review of coal mine permit applications. A water-quality station on Little Scrubgrass Creek

near Lisbon, provided continuous-record of stream stage, pH, specific conductance, and water temperature. Monthly water-quality samples collected at this station were analyzed for total and dissolved metals, nutrients, major cations and anions, and suspended sediment concentrations. Fourteen partial-record sites, located throughout the basin, were similarly sampled four times during the period of study. Streamflow and water-quality data obtained at these sites during various base flow periods are also presented. (Author's abstract)
W91-00357

ANNUAL YIELD AND SELECTED HYDROLOGIC DATA FOR THE ARKANSAS RIVER BASIN COMPACT ARKANSAS--OKLAHOMA 1989 WATER YEAR.
Geological Survey, Little Rock, AR. Water Resources Div.
M. A. Moore, T. E. Lamb, and L. D. Hauth.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 90-131, 1990. 35p, 1 fig, 3 tab, 3 ref. Prepared in cooperation with the Arkansas-Oklahoma Arkansas River Compact Commission.

Descriptors: *Arkansas, *Arkansas River Basin, *Arkansas River Basin Compact, *Hydrologic data, *Interstate compacts, *Oklahoma, *Water management, *Water yield, Hydrologic data collections, Water quality.

The computed annual yield and deficiency of the subbasins as defined in the Arkansas River Compact, Arkansas-Oklahoma, are given in tables. Actual runoff from the subbasins and depletion caused by major reservoirs in the compact area are also given in tabular form. Monthly maximum, minimum, and mean discharges are shown for the 14 streamflow stations used in computing annual yield. Water-quality data are shown for the Arkansas River at James W. Trimble Lock and Dam, near Van Buren, Arkansas, and Neosho River below Fort Gibson Lake near Fort Gibson, Oklahoma. (Author's abstract)
W91-00360

CATASTROPHE MODEL FOR THE FORCED HYDRAULIC JUMP.
Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ingenieria.
For primary bibliographic entry see Field 8B.
W91-00373

SIMULATION OF ONE-DIMENSIONAL DAM-BREAK FLOWS.
Florida International Univ., Miami. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 8A.
W91-00399

EFFECTS OF SUBURBANIZATION UPON SNOWMELT RUNOFF.
Trent Univ., Peterborough (Ontario). Dept. of Geography.
J. M. Buttle.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 3, p 285-302, June 1990. 4 fig, 6 tab, 30 ref.

Descriptors: *Rainfall-runoff relationships, *Snowmelt, *Suburban areas, *Urban hydrology, *Urban runoff, *Urbanization, Drainage area, Flood peak, Ontario, Runoff, Small watersheds.

The influence of suburbanization upon runoff response to snowmelt and rain-on-snow inputs was examined for a small drainage basin in south-central Ontario. Modification of more than 50 percent of the basin area over a 14 year period led to a six-fold increase in the spring quickflow response ratio and an increase in the number of snowmelt events that generate appreciable quickflow. Anticipated changes in mean peak discharge, time of rise and quickflow response ratio did not emerge, and the influence of development upon these streamflow characteristics may have been overshadowed by annual changes in basin antecedent conditions. The distinction between hydrograph properties associated with snowmelt and rain-on-snow events has become more pronounced with suburbanization. Rain-on-snow generated higher maximum peak flows and lower average peak discharge per unit input compared with snowmelt, and these differences were accentuated by development of the basin. Rain-on-snow also produced more variable time of rise values, while the reduction in hydrograph recession coefficients that accompanied suburban development was most apparent for snowmelt events. The results suggest that suburbanization can have a subtle, yet real influence upon basin runoff regime during spring snowmelt. (Author's abstract)
W91-00408

DISTRIBUTION OF MICRO-ARTHROPODS IN SOME SOUTHERN ENGLISH STREAMS: THE INFLUENCE OF PHYSICOCHEMISTRY.
Queen Mary Coll., London (England). School of Biological Sciences.
For primary bibliographic entry see Field 2H.
W91-00419

SIMPLIFIED METHODS OF ESTIMATING DAILY MEAN STREAM WATER TEMPERATURE.
Freshwater Biological Association, Ambleside (England).
D. T. Crisp.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 457-462, June 1990. 2 fig, 3 tab, 4 ref. Department of the Environment Contract PECD 7/7/159.

Descriptors: *Estimating, *Freshwater, *Statistical analysis, *Streams, *Water temperature, England, Mathematical methods.

For a small stream in upper Teesdale, northern England, estimates of the daily mean water temperature were obtained from: (a) the mean of temperature readings taken at regular but less frequent intervals than hourly (twelve, six and three times per day); (b) the daily mid-point (= 0.5(maximum + minimum)); (c) spot temperatures at two times in the day when the daily temperature trace usually crosses the mean value. These estimates were then compared with the 'true' daily mean (assuming that the average of twenty-four hourly temperature readings is the 'true' mean). The accuracy of the estimate of daily mean decreased with reduced frequency of reading but, even at only three readings per day, was always within plus or minus 0.5 C of the true value. Consolidation of the daily estimates gave estimates of monthly and annual means within plus or minus 0.1 C of the true value. Nearly 96% of estimates of the daily mean based on the 'first mean crossing' were within plus or minus 0.5 C of the true value and no bias could be shown. Estimation of the daily means from temperature at the time of the 'second mean crossing' was relatively complicated and gave less satisfactory results than did the first mean crossing. The daily mid-point and the temperature at the time of the first mean crossing gave a good general indication of daily mean temperatures. When consolidated to monthly or annual means the estimates were within plus or minus 0.25 C and 0.10 C respectively, of the true values. (Author's abstract)
W91-00421

INTERACTIONS AMONG NUTRIENTS, ALGAE AND INVERTEBRATES IN A NEW ZEALAND MOUNTAIN STREAM.
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
M. J. Winterbourn.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 463-474, June 1990. 6 fig, 3 tab, 39 ref.

Descriptors: *Algae, *Freshwater, *Invertebrates, *Mountain streams, *New Zealand, *Nutrients, *Streams, Aquatic life, Colonization, Forest watersheds, Insecticides, Larvae, Malathion, Midges, Nets, Periphyton, Pesticides, Pigments, Plankton, Scanning electron microscopy, Species diversity, Springs.

Colonization of nutrient-diffusing substrata by periphyton and invertebrates was investigated at forested and open sites in a small, mountain stream and a spring in the South Island of New Zealand. Substrata had colonization surfaces made from 100 micrometer mesh plankton netting that enabled algal assemblages to be removed intact for scanning electron microscopy. They also allowed small volumes of solvent to be used for the extraction of photosynthetic pigments. At all sites, periphyton assemblages were dominated by species of Achnanthes, Cocconeis and Gomphonema, and except in the forest in winter, periphyton biomass was always greater on enriched (N+P added) than control substrata. Invertebrates colonizing diffusion substrata were principally larval Chironomidae (Orthocladiinae). No larvae were present in winter, but in three spring and summer trials mean larval densities were higher on nutrient-enriched than control substrata at all sites. The inclusion of an insecticide Malathion in diffusion substrata, reduced insect colonization at open and forested sites. After 28 days, no concurrent increases in algal pigment concentration were observed on nutrient-enriched or control substrata at the forested site. However, pigment concentrations were higher on substrata incorporating Malathion at the open site, suggesting that algal standing crop was depressed by the activities of grazers. (Author's abstract)
W91-00422

WATER TEMPERATURE IN A STREAM GRAVEL BED AND IMPLICATIONS FOR SALMONID INCUBATION.
Freshwater Biological Association, Ambleside (England). Windermere Lab.
For primary bibliographic entry see Field 8I.
W91-00427

STREAMFLOW AND WATER-QUALITY DATA FOR MEADOW RUN BASIN, FAYETTE COUNTY, PENNSYLVANIA, DECEMBER 1987 - NOVEMBER 1988.
Geological Survey, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W91-00431

HYDROLOGIC AND WATER-QUALITY DATA FOR STREAMS AND IMPOUNDMENTS IN THE COTEAU DES PRAIRIES--UPPER MINNESOTA RIVER BASIN, 1979-84.
Geological Survey, St. Paul, MN.
C. J. Smith, G. A. Payne, and L. H. Tornes.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 88-84, 1990. 46p, 12 fig, 13 tab, 15 ref. Prepared in cooperation with the U.S. Army Corps of Engineers; U.S. Soil Conservation Service.

Descriptors: *Hydrologic data, *Minnesota River Basin, *Reservoirs, *Soil erosion, *Streams, *Water pollution sources, *Water quality, Coteau des Prairies, Sediment transport, Solute transport, Streamflow data, Water properties, Water sampling.

Water-quality and streamflow data were collected in the Coteau des Prairies region of southwestern Minnesota and eastern South Dakota from 1979-84. Data were collected to: (1) document the water quality characteristics of streams and impoundments in the Coteau area; (2) predict the impact of proposed impoundments; (3) define the amount of dissolved and suspended material transported; and (4) determine the differences in water quality between the impoundment inflows and outflows. Streamflow and water quality data were collected at 12 stream and four impoundment sites. Continuous record gages, set to collected data at 15-minute intervals, and readings taken by local observers wee used to complete discharge records at 10 stream sites and stage records at three impoundment sites. Automatic samplers and local observers collected storm runoff, sediment, and nutrient samples at 10 stream sites. Water quality samples were collected at various time and stage intervals during high flow and periodically during low flow. Primary emphasis in the stream-sampling program

was on analysis of samples for nutrients in 1980-82, and on analysis of suspended sediment and nutrients in 1983-84. Field measurements were made of pH, water temperature, dissolved oxygen, specific conductance, alkalinity, and bacteria. Secondary emphasis was on analysis of major dissolved substances. Primary emphasis in the impoundments was on analysis of samples for phosphorus and chlorophyll and on the measurement of transparency. Temperature and dissolved-oxygen concentrations were measured to determine the degree of stratification. All data collected during the study are given in this report. The tables list mean-daily stream discharge, results of water quality analyses, and bed material particle-size analyses at stream sites. The tables also list information on pool stage, water temperature, and transparency, on dissolved-oxygen, chlorophyll a, phytoplankton, and nutrient concentrations, and on chemical and particle-size analyses of bed material at impoundment sites. (Author's abstract)
W91-00434

RADAR DATA PROCESSING FOR HYDROLOGY IN THE CEVENNES REGION.
Laboratoire Central des Ponts et Chaussees, Bouguenais (France).
For primary bibliographic entry see Field 7B.
W91-00466

FLOOD MONITORING FROM SPACE IN CHINA.
Ministry of Water Resources, Beijing (China). Remote Sensing Application Center.
For primary bibliographic entry see Field 7B.
W91-00474

EFFECT OF TOSTON DAM ON UPSTREAM ICE CONDITIONS.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 6G.
W91-00574

RAINFALL-RUNOFF RELATIONS DERIVED FROM THE PROBABILITY THEORY OF STORAGE.
IBM Research Lab., Yorktown Heights, NY.
J. R. M. Hosking, and R. T. Clarke.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1455-1463, July 1990. 3 fig, 8 ref, append.

Descriptors: *Mathematical models, *Model studies, *Probability distribution, *Rainfall-runoff relationships, *Runoff forecasting, *Stream discharge, Evapotranspiration, Probabilistic process, Soil moisture deficiency, Soil moisture retention, Storage capacity.

The relationship between river discharge and the rainfall which causes it is one of the central problems of hydrology. Using a simplified representation of how a river basin stores precipitation, generates runoff, and loses water through evapotranspiration, probabalistic relationships between precipitation, soil moisture deficit, and generated runoff were derived. The 'distribution function model' was used to describe the soil moisture storage capacity of the basin: storage capacity, per unit of basin surface area, is regarded as a spatially variable quantity described by a density function. By routing the generated runoff through what is essentially a linear reservoir with stochastic inputs and outputs, it was shown how the median discharge can be calculated which corresponds to a rainfall input of some specified return period T time intervals. The return period for basin discharge can, with certain assumptions, also be calculated, thereby yielding probability statements relating the T-period rainfall to its resultant discharge. (Author's abstract)
W91-00592

EVALUATION OF AUTOMATED TECHNIQUES FOR BASE FLOW AND RECESSION ANALYSES.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
R. J. Nathan, and T. A. McMahon.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1465-1473, July 1990. 9 fig, 1 tab, 34 ref.

Descriptors: *Base flow, *Catchment areas, *Mathematical analysis, *Recession, *Streamflow forecasting, Analytical techniques, Australia, Comparison studies, Low flow, Mathematical models, Stream discharge.

Several automated techniques concerned with base flow separation and recession analyses were evaluated with the overall objective being the development of a regional model for use on ungauged catchments. Two base flow techniques were considered, one based on a digital filter and the other on simple smoothing and separation rules. A comparison between two commonly used techniques of recession analyses, the correlation method and the matching strip method, was also undertaken. The relative performances of the techniques were evaluated using the results obtained from the daily streamflow records of 186 catchments in southeastern Australia. It was found that the matching strip method yields more discriminating and accurate information about recession behavior than does the correlation method; indeed, the uncertainties inherent in the correlation method make it unsuited to the analysis of slow recession rates. Use of a simple digital filter with a parameter set to 0.925 was found to be a fast and objective method of continuous base flow separation. The results obtained using this technique were found to yield similar answers to those obtained using a traditional graphical technique for a range of stream variabilities and catchment sizes. (MacKeen-PTT)
W91-00593

ASSESSMENT OF A CONCEPTUAL RAINFALL-RUNOFF MODEL'S ABILITY TO REPRESENT THE DYNAMICS OF SMALL HYPOTHETICAL CATCHMENTS: 1. MODELS, MODEL PROPERTIES, AND EXPERIMENTAL DESIGN.
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W91-00604

ASSESSMENT OF A CONCEPTUAL RAINFALL-RUNOFF MODEL'S ABILITY TO REPRESENT THE DYNAMICS OF SMALL HYPOTHETICAL CATCHMENTS: 2. HYDROLOGIC RESPONSES FOR NORMAL AND EXTREME RAINFALL.
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W91-00605

LOGGING EFFECTS ON STREAMFLOW: STORM RUNOFF AT CASPAR CREEK IN NORTHWESTERN CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
For primary bibliographic entry see Field 4C.
W91-00610

RESOURCE LIMITATION IN A STREAM COMMUNITY: PHOSPHORUS ENRICHMENT EFFECTS ON PERIPHYTON AND GRAZERS.
Academy of Natural Sciences of Philadelphia, PA.
For primary bibliographic entry see Field 2H.
W91-00618

DAILY FLOW FORECASTING WITH REGRESSION ANALYSIS.
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, B. K. Huong, and P. D. Loi.
Water SA WASADV, Vol. 16, No. 3, p 179-184, July 1990. 5 tab, 9 ref.

Descriptors: *Flow pattern, *Mekong River Basin, *Regression analysis, *River flow, *River forecasting, *Streamflow forecasting, Comparison studies, Diurnal variation, Laos, Least squares method, Thailand.

Regression analysis methods have been used quite extensively in river flow forecasting. In this study, five commonly used regression methods, namely ordinary least squares, ridge, principal components, stepwise, and least absolute value regressions, were considered in the context of daily flow forecasting. For this comparative study, relevant data at two stations were used, from Nam Ngum Dam Site in Laos and from Ban Chot of the Chi River Basin in Thailand. From applications to these two catchments located in the Lower Mekong Basin, it was found that: (1) ordinary least squares, stepwise, and least absolute value regressions have very good and comparable forecasting capability which is better than that of the remaining two methods and; (2) stepwise regression is the least time-consuming method, while absolute value regression requires the most time. Having a very good performance, requiring the least computing time, and resulting in simpler equations, stepwise regression is the best among the methods considered. (Author's abstract)
W91-00634

PALAEOFLOOD HYDROLOGY: A TOOL FOR SOUTH AFRICA--AN EXAMPLE FROM THE CROCODILE RIVER NEAR BRITS, TRANSVAAL, SOUTH AFRICA.
Geological Survey, Pretoria (South Africa). Regional Geology Div.
A. M. Smith, and P. K. Zawada.
Water SA WASADV, Vol. 16, No. 3, p 195-200, July 1990. 4 fig, 3 tab, 21 ref.

Descriptors: *Flood data, *Historic floods, *Indirect flood measurement, *Paleohydrology, *South Africa, Crocodile River, Data acquisition, Geological terraces, Hydrologic data collections, Maximum probable floods, Probable maximum flood.

At present, in South Africa the estimation and prediction of high magnitude flows are based solely on conventional flood frequency analysis using a short gauged record (national average of 30 years). The problem is further compounded in areas of the country where no, or inadequate, gauging stations exist. This inadequate record can be augmented by the application of paleoflood hydrological (PFH) techniques. In this study, PFH techniques were applied to a reach of the Crocodile River. These techniques utilized hydrological calculations based on terrace levels and particle size analysis which were then compared to the gauged record. PFH analysis yielded discharges similar to the 1918 and 1978 extreme flood events documented from the gauged record. In addition, PFH analysis identified four prehistoric floods with discharges of 4500, 6000, 7000 and 9500 cu m/sec. The first three discharges are believed to have occurred under the present climatic and fluvial regime. The latter figure may have occurred under a different climatic regime and therefore may represent a relict feature. If the 9500 cu m/sec event is excluded, then 7000 is the maximum calculated discharge. This figure approximated the regional maximum flood (RMF) value of 6415 cu m/sec as calculated using the Francou-Rodier equation. PFH therefore represents an independent method of testing the validity of the RMF. In view of the short gauging record in South Africa and the increasing development adjacent to river courses, PFH represents a valuable tool for identifying extreme flood events. Such data will be of considerable assistance to flood plain management. (Author's abstract)
W91-00636

BENTHIC TURFS VS FLOATING MATS OF ALGAE IN RIVER FOOD WEBS.
California Univ., Berkeley. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00708

RESISTANCE OF LOTIC ECOSYSTEMS TO A LIGHT ELIMINATION DISTURBANCE: A LABORATORY STREAM STUDY.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2H.

W91-00709

EFFECTIVE MODELLING OF A MAJOR INLAND OIL SPILL ON THE OHIO RIVER.
Ohio State Univ., Columbus. School of Natural Resources.
For primary bibliographic entry see Field 5B.
W91-00714

STEADY UNIFORM FLOW IN PRISMATIC CHANNELS WITH FLOOD PLAINS.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Civil Engineering.
T. Dracos, and P. Hardegger.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 2, p 169-185, 1987. 7 fig, 4 tab, 18 ref.

Descriptors: *Channel flow, *Flood plains, *Flow models, *Model studies, *Open-channel flow, *Stage-discharge relations, Computers, Flood channels, Mathematical models, Prismatic channels, Roughness coefficient, Uniform flow, Unsteady flow.

Most of the methods used for the computation of uniform flow in channels with flood plains are based on a separate determination of the flow in the main channel and the flood plains. A single method is proposed which allows the direct determination for the stage-discharge relation in a channel with a flood plain. The empirical method presented for the computation of the depth-discharge relation in compound channels is based on experimental results published by other investigators. Within the limitations posed by the restricted number of tests, especially with roughness of the flood plains different from the roughness of the main channel, it was possible to develop empirically a set of relations which allow one to determine the apparent roughness coefficient of a compound channel. With the help of this coefficient the stage-discharge relation in channels with flood plains can be computed by the single channel method. For channels with roughness of the flood plains different from roughness of the main channel the effective roughness coefficient must first be computed by using the Einstein-Horton formula. The procedure described for the determination of the apparent roughness coefficient can also be used to determine the apparent roughness coefficient needed for the computation of gradually varied as well as unsteady flow in channels with flood plains, provided the flow conditions are such that a one-dimensional treatment is permissible. Furthermore, the relations developed for that purpose are suitable for computer applications and can easily be incorporated in existing computer programs. The approach gives satisfactory results. (Agostine-PTT)
W91-00761

PERTURBATION SOLUTION OF THE FLOOD-ROUTING PROBLEM.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W91-00763

SEDIMENT YIELD AND DISCHARGE IN MOUNTAINOUS SMALL RIVER BASINS: ACTUAL CONDITION OF SEDIMENT DISCHARGE AFTER DAMAGE CAUSED BY SAND AND STONE AVALANCHES (IN JAPANESE).
For primary bibliographic entry see Field 2J.
W91-00766

CLASSIFICATION OF THE MACROINVERTEBRATE FAUNA OF TWO RIVER SYSTEMS IN SOUTHWESTERN AUSTRALIA IN RELATION TO PHYSICAL AND CHEMICAL PARAMETERS.
Western Australia Univ., Nedlands. Aquatic Research Lab.
For primary bibliographic entry see Field 2H.
W91-00774

VARIABILITY OF RESULTS FROM THE USE OF PHABSIM IN ESTIMATING HABITAT AREA.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W91-00775

EFFECTS OF SEDIMENT AND FLOW REGIME ON THE AQUATIC INSECTS OF A HIGH MOUNTAIN STREAM.
Wyoming Univ., Laramie. Dept. of Plant Science.
For primary bibliographic entry see Field 2H.
W91-00776

EFFECT OF REGULATION ON 0+ FISH RECRUITMENT IN THE GREAT OUSE, A LOWLAND RIVER.
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
For primary bibliographic entry see Field 6G.
W91-00777

ENHANCEMENT OF BENTHIC MACROINVERTEBRATES BY MINIMUM FLOW FROM A HYDROELECTRIC DAM.
Versar, Inc., Columbia, MD.
For primary bibliographic entry see Field 6G.
W91-00778

ASSESSING OPTIONS FOR STREAM REGULATION USING HYDROLOGIC SIMULATIONS AND CUMULATIVE IMPACT ANALYSIS: FLATHEAD RIVER BASIN, USA.
Montana Power Co., Butte.
J. H. Jourdonnais, J. A. Stanford, F. R. Hauer, and C. A. S. Hall.
Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 3, p 279-293, June/July 1990. 6 fig, 5 tab, 49 ref.

Descriptors: *Hydraulic models, *Montana, *Regulations, *River systems, *Stream regulation, *Water resource management, Environmental impact, Flathead River, Multiobjective planning, River regulations, Tradeoff analysis, Wildlife conservation.

A study was conducted to resolve regulation problems upstream and downstream of Flathead Lake and on the lake proper. Members of a technical working group, representing eight water and wildlife management agencies, contributed 75 regulation scenarios they deemed necessary to conserve or enhance ecological (fish and wildlife) and societal (hydropower production, flood control, and recreation) resources for which they had management authority. The hydrology model simulated the effect of each scenario on system water balance; scenarios that were within the physical and legal constraints of the system were accepted for determination of cumulative impacts on resources. A multiattribute tradeoff analysis was used to assess cumulative impacts to key resources as a consequence of each regulation scenario (simulation) accepted for evaluation. Impacts were subjectively and independently quantified by each member of the working group following a point and importance weighing system agreed to a priori. Valuation of impacts was done on the basis of 36 technical studies of the effects of regulation on system resources. Impact valuations were summed to yield a variable referred to as weighted cumulative impact (WCI), where the highest, positive WCI indicated least cumulative impact on resources. Scenarios were then ranked in terms of WCI. When ecological resources only were evaluated, the preregulation Flathead Lake scenario generated the highest WCI. However, when all resources were considered, scenarios ranked very differently but a preferred alternative was identified by virtue of its highest WCI. This interactive process of hydrology simulation and computation of cumulative impacts mediated resource conflicts and served as an important tool in deriving water management recommendations in the Flathead River Basin. (Author's abstract)
W91-00779

SEASONAL VARIATION OF SIRODOTIA DELICATULA SKUJA (RHODOPHYTA, BATRACHOSPERMACEAE) IN A SMALL STREAM FROM SAO PAULO STATE, SOUTHEASTERN BRAZIL.
Universidade Estadual Paulista, Sao Jose do Rio Preto (Brazil). Inst. de Biociencias.
For primary bibliographic entry see Field 2H.
W91-00782

WATER CHEMISTRY OF THE SOLIMOES/AMAZON RIVER (A HIDROQUIMICA DO RIO SOLIMOES/AMAZONAS).
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
For primary bibliographic entry see Field 2K.
W91-00820

NUTRIENT DYNAMICS OF DECOMPOSING LEAVES FROM AMAZONIAN FLOODPLAIN FOREST SPECIES IN WATER.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W91-00824

SPATIAL AND TEMPORAL VARIATION IN FISHES OF RIFFLE HABITATS: A COMPARISON OF ANALYTICAL APPROACHES FOR THE ROANOKE RIVER.
Oklahoma Univ., Kingston. Biological Station.
For primary bibliographic entry see Field 8I.
W91-00868

STUDIES ON THE ALGAE OF A SMALL SOFTWATER STREAM I. OCCURRENCE AND DISTRIBUTION WITH PARTICULAR REFERENCE TO THE DIATOMS.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
For primary bibliographic entry see Field 2H.
W91-00869

STUDIES ON THE ALGAE OF A SMALL SOFTWATER STREAM II. ALGAL STANDING CROP (MEASURED BY CHLOROPHYLL-A) ON SOFT AND HARD SUBSTRATA.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
For primary bibliographic entry see Field 2H.
W91-00870

STUDIES ON THE ALGAE OF A SMALL SOFTWATER STREAM III. INTERACTION BETWEEN DISCHARGE, SEDIMENT COMPOSITION AND DIATOM FLORA.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
For primary bibliographic entry see Field 2H.
W91-00871

DIURNAL FLUCTUATION IN STREAM FLOW AND IN SPECIFIC ELECTRIC CONDUCTANCE DURING DROUGHT PERIODS.
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
D. Kobayashi, K. Suzuki, and M. Nomura.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 105-114, July 1990. 9 fig, 1 tab, 3 ref.

Descriptors: *Drought effects, *Evapotranspiration, *Forest hydrology, *Japan, *Soil-water-plant relationships, *Streamflow, *Surface-groundwater relations, *Vegetation effects, Diurnal variation, Groundwater movement, Headwaters, Hydrograph analysis, Hydrologic data, Ion transport, Seasonal variation.

Many hydrologists have been interested in the diurnal fluctuation in stream flow during a summer drought, but there are few reports on this subject. In a headwater basin covered with boreal forest in northern Japan, drought flow was observed in winter and in summer. In summer drought it was found that remarkable diurnal fluctuation of stream

flow and of electric conductance is caused by daytime evapotranspiration. It was found that the daily reduction in stream flow was accompanied by a reduction in the total ion concentration. The drought hydrograph was separated into two components assuming the drought flow to be a mixture of ionically dense throughflow and of ionically dilute groundwater flow entering the stream in its lower reaches. It was judged that the diurnal fluctuation of streamflow was the result not of direct evaporation from the stream channel, but of daily evapotranspiration from the forest along the stream channel, for the following reasons: (1) reduction of streamflow in the daytime accompanied reduction of total ion concentration. When direct evaporation from the stream occurs, the ions in the flow will be concententrated; and (2) The dewpoint measured is near or higher than the stream temperature, and therefore the evaporation from the stream is small or negative. Therefore the streamflow would diminish with the reduction of inflow by evapotranspiration. Discrepancy of the trends of daily fluctuation of ion concentration for SO3(2-) and Mg(2+) suggests selective absorption of ions by tree roots. (Hoskin-PTT)
W91-00881

TOPOGRAPHIC EFFECTS ON FLOW PATH AND SURFACE WATER CHEMISTRY OF THE LLYN BRIANNE CATCHMENTS IN WALES.
Geological Survey, Trenton, NJ.
D. M. Wolock, G. M. Hornberger, and T. J. Musgrove.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 243-259, July 1990. 7 fig, 6 tab, 37 ref.

Descriptors: *Acid rain, *Flow models, *Flow profiles, *Geomorphology, *Model studies, *Surface flow, *Topography, *Wales, *Watersheds, Catchment areas, Hydrogen ion concentration, Mathematical analysis, Slopes, Surface runoff.

Topographic shape is a watershed attribute thought to influence the flow path followed by water as it traverses a catchment. Flow path, in turn, may affect the chemical composition of surface waters. Topography is quantified in the hydrological model TOPMODEL as the relative frequency distribution of the index ln(a/tanB) where a is the upslope area per unit contour that drains past a point and tanB is the local surface slope. Spatial distributions of ln(a/tanB) were calculated for eight catchments in Wales on a 25 m x 25 m grid. Among the catchments, mean observed stream hydrogen ion concentration during high flow periods was highly correlated with the mean of the ln(a/tanB) distribution. The steady-state gain of a transfer function (time series) model relating hydrogen ion concentration to discharge was positively correlated with the mean of the ln(a/tanB) distribution. These results suggest that during high flow periods, both the average stream acidity and the magnitude of fluctuations in hydrogen ion concentration are conditioned by the topographic shape of the catchment. By performing a sensitivity analysis on TOPMODEL, it was also shown that as the mean of the ln(a/tanB) distribution for a catchment increases, so does its theoretical likelihood to produce significant quantities of surface and near-surface runoff. The observed results in the Llyn Brianne catchments are consistent with this theoretical expectation in that surface or near-surface runoff is often higher in acidity than are deeper sources of hillslope runoff. (Author's abstract)
W91-00888

CHEMICAL STUDIES OF CHLORIDE AND STABLE OXYGEN ISOTOPES IN TWO CONIFER AFFORESTED AND MOORLAND SITES IN THE BRITISH UPLANDS.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W91-00890

USING RN222 TO EXAMINE GROUNDWATER/SURFACE DISCHARGE INTERACTION IN THE RIO GRANDE DE MANATI, PUERTO RICO.
Florida Univ., Gainesville. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00893

NEW DIRECTIONS FOR SURFACE WATER MODELING.
For primary bibliographic entry see Field 7C.
W91-00961

TOWARDS AN IMPROVED SYSTEM FOR WEATHER RADAR CALIBRATION AND RAINFALL FORECASTING USING RAIN-GAUGE DATA FROM A REGIONAL TELEMETRY SYSTEM.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2B.
W91-00963

USE OF SATELLITE DERIVED RAINFALL ESTIMATES AS INPUTS TO FLOW PREDICTION IN THE RIVER SENEGAL.
Reading Univ. (England). Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W91-00964

EVALUATION AND PREDICTION OF POSSIBLE MAN-INDUCED CHANGES IN THE HYDROLOGICAL CYCLE.
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 4C.
W91-00967

PHYSICS-BASED APPROACH TO STOCHASTIC HYDROLOGY OF FIRST-ORDER DRAINAGE BASINS.
California Univ., Davis. Dept. of Civil Engineering.
M. L. Kavvas, R. S. Govindaraju, and M. N. Saquib.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 63-71. 2 fig, 9 ref. NSF Grant CEE-8411896.

Descriptors: *Catchment areas, *Hydrological models, *Mathematical models, *Model studies, *Rainfall-runoff relationships, *Stochastic models, Differential equations, Flow models, Overland flow, Streamflow, Subsurface flow.

The methodology for a physics-based solution to the stochastic hydrology of first-order drainage basins is discussed. A first-order drainage basin is defined as one which is drained by a single Hortonian first-order stream. It is considered as the basic basin unit which acts as the building block for higher order, complex basins. It is made up of overland flow, subsurface flow and streamflow zones. The flow processes in these three zones interact with each other through the zone boundaries. The partial differential equations, describing the flow processes in each of the zones, together with the boundary conditions and the initial conditions form the nonlinear physics-based mathematical model of the first-order basin hydrology. Within the framework of this mathematical model the uncertainties in the various components of the first-order basin hydrology are identified and the solution methodology for the resulting nonlinear stochastic partial differential equations of the first-order basin hydrology is outlined. (See also W91-00961) (Author's abstract)
W91-00968

MODULAR MODEL FOR SIMULATING CONTINUOUS OR EVENT RUNOFF.
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
D. Stephenson.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 83-91. 4 fig, 8 ref.

Descriptors: *Aquifers, *Computer models, *Groundwater, *Hydrologic models, *Model studies, *Physical models, *Rainfall-runoff relationships, *Storm runoff, *Storm water, *Surface runoff, Computer programs, Simulation.

Stormwater model arrangements are reviewed on the basis of the ease of initial access or re-access and the ease of learning its principles and limitations. Computer programs able to assemble loosely-connected elements are simplest to use and understand. Arrangements of elements and assembly in parallel or series enables all possible types of models to be accommodated. Hydraulic elements are used for surface runoff visualization and groundwater aquifers are simulated in parallel for continuous or long-term simulations. The following modules can be built in to computer programs: catchments, circular conduits (pipes), trapezoidal channels, compound channels, storage basins, and aquifers. (See also W91-00961) (Author's abstract)
W91-00970

USE OF KINEMATIC WAVE METHOD TO ASSESS EFFECTS OF URBAN DEVELOPMENT ON FLOOD PEAK CHANGES.
Nanyang Technological Inst., Singapore. School of Civil and Structural Engineering.
For primary bibliographic entry see Field 4C.
W91-00971

ENTROPY BASED METHOD FOR FLOOD FORECASTING.
Louisiana Geological Survey, Baton Rouge.
P. F. Krstanovic, and V. P. Singh.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. 105-113. 3 fig, 1 tab, 10 ref.

Descriptors: *Flood forecasting, *Hydrologic models, *Mathematical models, *Model studies, *Rainfall-runoff relationships, *River flow, *Stochastic models, *Streamflow forecasting, Entropy.

The entropy theory was used to develop a univariate model for forecasting of long-term streamflow. The model modifies the original Burg equations from the maximum entropy spectral analysis (MESA), and uses autocovariance matrix of streamflow record. The model was verified on five rivers from different regions of the world (Rio Orinoco and Rio Caroni in Venezuela, Krishna River and Godavari River in India, and Spring Creek in Louisiana). The streamflow model predicted periodicity and trend reasonably well. The streamflow model and the ARIMA model were comparable in forecasting in the case of not very irregular streamflows. For such cases, theoretical equivalency existed between the two models. The streamflow and ARIMA models, despite a long record, gave completely different forecasts for very irregular streamflows. The streamflow periodicity in the ARIMA model was accounted for by either AR(12) or MA(12) parameters. The streamflow model accounted for this seasonality by including the seasonal Lagrange multipliers. The model can be applied to any other univariate stationary hydrologic process, where stochasticity is not of high order (i.e., minute rainfall). (See also W91-00961) (Author's abstract)
W91-00972

ASSESSMENT OF NETWORK MODELS IN FLOOD FORECASTING.
Bureau of Meteorology, Hobart (Australia).
T. A. Malone, and I. Cordery.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 115-124. 3 fig, 3 tab, 7 ref.

Descriptors: *Flood basins, *Flood forecasting, *Flood hydrographs, *Hydrologic models, *Model studies, *Network models, *Rainfall-runoff rela-

tionships, Australia, New South Wales, Streamflow forecasting.

Two similar, non-linear, network models were applied to three basins in coastal New South Wales to examine their potential for use in operational flood forecasting. Network models have the potential to make direct allowance for non-uniform spatial distribution of rainfall, as well as to provide for non-linear basin response to the input rainfall. The two models were applied under operational flood forecasting conditions to data for 7 or 8 observed floods on each basin and their ability to reproduce the observed hydrographs was examined. These results were compared with those obtained from the unit hydrograph approach which is currently used for flood forecasting on these basins. The results indicate that the determination of excess rainfall is probably more critical than the type of model used to calculate the direct runoff hydrograph. There appears to be little difference between the abilities of the unit hydrograph and the network models to reproduce the observed hydrographs on these three basins which ranged in size from 630 to 10,000 sq km. However overall, the network models appear to offer a number of advantages over the unit hydrograph for flood forecasting, especially in larger basins, including: (1) the ability to model the spatial variation in rainfall; (2) the potential to model the variation in loss parameters: and (3) the ability to alter predetermined calibration parameters to suit observations as a flood progresses. (See also W91-00961) (Author's abstract)
W91-00973

FLOODS AND DROUGHTS IN LABE RIVER BASIN: THE HYDROGRAPH SHAPE.
Hydrometeorologicky Ustav, Prague (Czechoslovakia).
J. Buchtele.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 133-142. 9 fig, 4 tab, 5 ref.

Descriptors: *Drought, *Flood basins, *Flood hydrographs, *Flood waves, *Floods, *Hydrograph analysis, *Hydrologic models, *Rainfall-runoff relationships, *River basins, Air pressure, Air temperature, Czechoslovakia, Europe, Labe River Basin, Simulation.

Rainfall and runoff daily data for the 60-year period 1895-1954 were used for evaluation of flood waves in the Labe River basin in Czechoslovakia with an area of more than 50,000 sq km. The tendency of rainfall cells maxima to appear at the same place in the span of several days or weeks is illustrated. Small discharge waves then occur before large floods. Regional rainfall usually begins in the afternoon and rarely lasts more than 48 hours. The characteristics of spatial non-uniformity of rainfalls were used as parameters for Instantaneous Unit Hydrograph variability in the Sacramento model. For drought periods, the influence of air pressure and fall of air temperature below the freezing point on hydrograph recession curves are demonstrated. (See also W91-00961) (Author's abstract)
W91-00975

REVIEW OF THE SEARCH FOR A QUANTITATIVE LINK BETWEEN HYDROLOGIC RESPONSE AND FLUVIAL GEOMORPHOLOGY.
Massachusetts Inst. of Tech., Cambridge.
R. L. Bras, and I. Rodriguez-Iturbe.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 149-163. 6 fig, 31 ref. NSF Grant ECE-8513556.

Descriptors: *Channel morphology, *Geomorphology, *Hydrographs, *Hydrological models, *Mathematical models, *Model studies, *River basins, Reviews, Unit hydrographs.

Channels in a river basin generally develop in a tree-like structure with the outlet stream as the main truck and upstream reaches a bifurcating pattern of smaller and smaller branches. These networks exhibit tremendous regularity and organization, expressed not only in the geometry but in the size and relationship between the parts. Many results exist describing, at least in two planar dimensions, the structure of the channel network. Some essential descriptors of channel networks are reviewed in order to present the most recent results linking hydrology and fluvial geomorphology. Areas of research are highlighted in the context of available results on the geomorphologic unit hydrograph. (See also W91-00961) (Author's abstract)
W91-00977

GEOMORPHOCLIMATIC DERIVATION OF FLOOD FREQUENCY (PEAK AND VOLUME) AT THE BASIN AND REGIONAL SCALE.
Politecnico di Milano (Italy). Inst. of Hydraulics.
B. Bacchi, R. Rosso, D. Adom, and A. Brath.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 165-176. 4 fig, 36 ref.

Descriptors: *Flood basins, *Flood frequency, *Flood peak, *Geomorphology, *Rainfall-runoff relationships, *Runoff volume, Hydrological models, Sensitivity analysis, Storms.

A theoretical analysis is presented which permits the determination of the second order properties of peak discharge and runoff volume, based only on the knowledge of the rainfall statistics at a point, without recourse to any assumption about the underlying distribution. The analysis accounted for the effects due to spatial integration of precipitation over the basin area, absorption and rainfall-runoff transformation. Three dimensionless geomorphoclimatic parameters were used to describe the interaction of the rainfall field with basin area, absorption, and network response. A sensitivity analysis of the derived second order properties revealed the strong influence exerted by the scale and geomorphoclimatic characteristics of the basin. The results suggest the use of some caution in regionalization procedures for flood frequency analysis, especially with regard to the identification of homogeneous regions, based on the delineation of zones with nearly constant values of the dispersive characteristics of recorded flood data. (See also W91-00961) (Author's abstract)
W91-00978

REGIONALIZATION OF MODEL PARAMETERS FOR A LARGE WATERSHED.
Seoul National Univ. (Republic of Korea). Dept. of Civil Engineering.
J. Sonu.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 177-185. 5 fig, 1 tab, 4 ref.

Descriptors: *Flood forecasting, *Flood stages, *Hydrological models, *Model studies, *Rainfall-runoff relationships, *River basins, *Watersheds, Computer models, Flood routing, Han River basin, Korea, Reservoir operation.

The forecasting of the flood stage at major points along a river requires a simple but accurate forecasting model. The method known as the storage function method was used for the prediction of the flood stage which basically employs the continuity equation and equation of motion. The equation of motion expresses the non-linear relation of storage and discharge. The parameters associated with the model were determined by finding the relation between parameter and basin characteristics. The computed and observed hydrographs in the case of the Han River basin in Korea were compared and the parameters readjusted for better forecasting. The model has the advantage of using basically the same equations for the watershed channel and reservoir routing which makes programming simpler and computer time shorter. (See also W91-00961) (Author's abstract)
W91-00979

ANALYTICAL RELATIONSHIPS BETWEEN RAINFALL AND RUNOFF FOR A PROBABILITY-DISTRIBUTED MODEL OF BASIN RESPONSE.
Instituto de Pesquisas Hidraulicas, Porto Alegre (Brazil).
R. T. Clarke.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 187-193. 1 fig, 8 ref.

Descriptors: *Mathematical models, *Model studies, *Rainfall-runoff relationships, *River basins, *Runoff, *Soil water, Evapotranspiration, Probability distribution.

Using a probability-distributed model of basin response, the frequency characteristics of runoff generation are shown to be related analytically to the frequency characteristics of precipitation and of potential evapotranspiration. A relationship was derived for the cumulative probability distribution of runoff depth generated during a time interval in terms of (1) the transition probabilities in a two-state (wet-dry) Markov chain that is used to describe transitions from wet to dry periods and conversely; (2) the probability distribution of rainfall depths occurring in time intervals within wet periods; (3) a function H, the cumulative probability distribution for soil moisture deficit, where H is conditional on s, the soil moisture capacity (regarded as spatially variable); and (4) a density function p(s)ds giving the proportion of basin area with soil moisture capacity in the range (s, s+ds). (See also W91-00961) (Author's abstract)
W91-00980

CONCEPTUAL MODEL SIMULATING THE HYDROLOGICAL PROCESSES ON A DRAINAGE BASIN IN A PLAIN AREA.
Hohai Univ., Nanjing (China). Dept. of Hydrology.
X. R. Liu.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 195-202. 4 fig, 1 tab, 7 ref.

Descriptors: *Catchment areas, *Groundwater, *Hydrological models, *Model studies, *Rainfall-runoff relationships, *River basins, *Surface-groundwater relations, *Water table, Aquifers, Discharge hydrographs, Evaporation, Groundwater movement, Groundwater storage, Infiltration, Soil water, Water table fluctuations.

A conceptual model was developed to simulate the hydrological processes on a drainage basin in a plain area where the vertical fluxes predominate and where the groundwater table is very close to the surface and, therefore, the interaction between surface water and groundwater should be taken into account. The hydrological components of the system are described in the model by means of four storages and their governing rules which are drawn from experience as well as theoretical knowledge. The model predicts the discharge at the outlet of the basin based on the input data of rainfall and pan evaporation. It is also capable of predicting groundwater table depth at each rainfall station. This model, a compromise between the excessively physical and the excessively empirical, has the following advantages: (1) It uses common hydrological and meteorological data; (2) It can be applied to different sizes of drainage basins; (3) It produces groundwater table fluctuations as well as discharge hydrographs; and (4) Consideration of the fluctuation of the groundwater table forces the simulation of infiltration, evaporation, and ground-

water flow to be more explicit, and places a constraint on the model structure, which makes it more reliable. (See also W91-00961) (Sand-PTT)
W91-00981

EFFECTS OF RECHARGE SYSTEMS ON HYDROLOGICAL INFORMATION TRANSFER ALONG RIVERS.
9 Eylul Univ., Izmir (Turkey). Dept. of Civil Engineering.
N. Harmancioglu, and T. Baran.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 223-233. 7 fig, 3 ref.

Descriptors: *Data interpretation, *Hydrologic models, *Information transfer, *Karst hydrology, *Rainfall-runoff relationships, *River basins, *Runoff, *Surface-groundwater relations, Regression analysis, Seasonal variation, Snow, Turkey.

Concepts of 'transferrable' and 'transferred' information are used for the analysis of information transfer between runoff-runoff and precipitation-runoff processes in basins with different recharge systems. Two basins were studied: (1) the Skizdere Basin in northeastern Turkey along the Black Sea Coast; and (2) the Aras Basin in eastern Turkey which receives much of its precipitation as snow. The results show within-the-year variation of transferred and transferable information to reflect how each basin responds to seasonally varying inputs. In basins with precipitation as the basic input to produce runoff, information transfer between selected points along a river is determined significantly by the similarity between their climatic factors. In karstic basins, however, neither runoff-runoff nor precipitation-runoff regressions are sufficient to transfer information especially during the non-rainy seasons, as sub-basins with different degrees of karstification respond diversely to input precipitation. (See also W91-00961) (Author's abstract)
W91-00984

NEW PERSPECTIVES ON DEVELOPMENTS IN MODELING OF EFFECTIVE RAINFALL BY APPLYING THE FDTF METHOD (NOUVELLES PERSPECTIVES DE DEVELOPPEMENT DANS LA MODELISATION DES PLUIES EFFICASES PAR APPLICATION DE LA METHODE DPFT).
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
J. Y. Rodriguez, D. Sempere, and C. Obled.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 235-244. 10 fig, 1 tab, 14 ref. English summary.

Descriptors: *Hydrological models, *Model studies, *Rainfall, *Rainfall-runoff relationships, *Watersheds, France, Unit hydrographs.

The FDTF approach identifies, on a multievent set, both the response function on the watershed and the series of excess rainfall associated with each event. The algorithm is alternate and iterative, and some improvements have been included in the deconvolution phase. Compared to the classical unit hydrograph approach, the major breakthrough consists of identifying an a priori consistent excess rainfall series that allows an objective calibration of any runoff function or infiltration model. A case study is provided, based on a small experimental watershed (554 sq km) in Cevennes southern France. (See also W91-00961) (Author's abstract)
W91-00985

REGIONAL METHODS FOR ESTIMATION OF DESIGN FLOODS FOR SMALL TO MEDIUM SIZED DRAINAGE BASINS IN AUSTRALIA.
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. H. Pilgrim.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 247-260, 3 fig, 1 tab, 20 ref.

Descriptors: *Design floods, *Flood forecasting, *Flood frequency, *Rainfall-runoff relationships, *Regional analysis, *Regional floods, Australia, Basins, Catchment areas, Estimating, Hydrological models, Statistical analysis.

In terms of overall economic value, design for small to medium sized rural basins is the most important aspect of flood estimation. Methods for these basins need to be based on observed flood data in the region, and should be simple to apply and familiar to designers, unambiguous in application, and of a probabalistic nature. As design sites are normally ungaged, regionalized procedures are required, but these methods must also recognize major differences in flood producing characteristics between different regions. Design methods to fulfill these requirements have been derived for most of Australia for inclusion in a revised edition of Australian Rainfall and Runoff, the guide to flood estimation published by the Institution of Engineers Australia. The regional methods derived from observed data are of two general types, the probabilistic Rational Method and regional flood frequency procedures. Values of design parameters show much less variation with basin characteristics than for previously used methods based on judgement or plot experiments. The flood estimates are also of much greater accuracy. (See also W91-00961) (Author's abstract)
W91-00986

DETERMINATION OF DESIGN FLOOD HYDROGRAPHS BASED ON REGIONAL HYDROLOGICAL DATA.
Graz Univ. (Austria). Inst. for Hydromechanics, Hydraulics and Hydrology.
H. Bergman, and B. Sackl.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 261-269. 4 fig, 7 ref.

Descriptors: *Design floods, *Flood forecasting, *Flood frequency, *Flood hydrographs, *Model studies, *Rainfall-runoff relationships, *Regional analysis, *Regional floods, Flood peak, Frequency analysis, Hydrological models, Probabilistic process, Statistical analysis, Stochastic models.

Knowledge of the probability of flood hydrographs is necessary for many problems in water management. The determination becomes difficult as a result of missing data in ungaged catchments and by the mathematical definition and evaluation of multivariate probability of the entire flood hydrograph. A stochastic-deterministic model was developed in an attempt to provide a better probabilistic description of the multivariate flood-process. The estimation of flood characteristics, such as peak runoff, volume and time course is based on basin properties and regional flood analysis. The determination of flood hydrograph probability is founded upon a bivariate statistical analysis of peaks Q-D and volumes V-D of the direct runoff. (See also W91-00961) (Sand-PTT)
W91-00987

REGIONAL ANALYSIS OF THE MEAN ANNUAL FLOOD AND OF FLOOD FREQUENCY CHARACTERISTICS.
National Technical Univ., Athens (Greece). Div. of Water Resources.
M. Mimikou, and J. Gordios.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 271-281. 1 fig, 3 tab, 11 ref.

Descriptors: *Flood forecasting, *Flood frequency, *Greece, *Hydrological models, *Model studies, *Rainfall-runoff relationships, *Regional analysis, Climates, Frequency analysis, Geomorphology, Rainfall intensity, Soil types, Statistical analysis.

An attempt was made to predict the mean annual flood of daily and of instantaneous extremes and flood quantiles for basins in a hydrologically homogeneous region. The variation of the mean annual flood and of the parameters of the Extreme Value type 1 distribution for basins in northwestern and western Greece are explained in terms of geomorphoclimatic characteristics of the basins. These characteristics are: drainage area, mean annual areal precipitation, stream frequency, main stream slope and length, intensity of the 1-day, 5-year return period rainfall and a soil type index. The developed regional models predict with satisfactory accuracy the mean annual floods and flood quantiles needed in hydrologic design, for ungaged basins of the region studied. (See also W91-00961) (Author's abstract)
W91-00988

ASSESSMENT OF THE US CONSERVATION SERVICE METHOD FOR ESTIMATING DESIGN FLOODS.
Brawijaya Univ., Malang (Indonesia). Fakultas Teknik.
A. A. Hoesein, D. H. Pilgrim, G. W. Titmarsh, and I. Cordery.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 283-291. 2 fig, 4 tab, 18 ref.

Descriptors: *Design floods, *Flood forecasting, *Flood frequency, *Hydrological models, *Rainfall-runoff relationships, Australia, Frequency analysis, Statistical analysis.

The U.S. Soil Conservation Service (SCS) method was tested as a design flood procedure in two regions in southeastern Australia. Runoff curve numbers were derived from observed data on a probabilistic rather than an event basis, fitting the design case. Derived values depended on the method for determining time of concentration and the average recurrence interval of the design flood, and to a minor extent on basin characteristics. Values derived by the normal SCS handbook procedure were shown to give very poor estimates of flood frequency values. Mapping of derived values provides a satisfactory basis for flood design. (See also W91-00961) (Author's abstract)
W91-00989

REGIONAL FLOOD FREQUENCY ANALYSIS USING RIDGE REGRESSION.
Hydro-Quebec, Montreal.
R. Roy, B. Bobee, F. Ashkar, and F. Roberge.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 293-300. 3 tab, 10 ref.

Descriptors: *Flood forecasting, *Flood frequency, *Frequency analysis, *Regional analysis, Canada, Comparison studies, Quebec, Regression analysis, Ridge regression, Statistical analysis.

Regional analysis has been proposed for estimating flow quantiles using ordinary multiple regression with basin physiographic and climatic characteristics as independent variables. The high pairwise correlation existing among the predictors suggests that ridge regression, which is more capable of overcoming the problems of multicollinearity, would give better results. The efficiency of both multiple regression and ridge regression in estimating quantiles was evaluated using physiographic characteristics of small drainage basins in Quebec, Canada. Using a jackknife type technique, it is shown that for the Canadian rivers studied and under certain conditions, ridge regression models

improve the multiple regression solutions. (See also W91-00961) (Sand-PTT)
W91-00990

HYDROLOGY AND MANAGEMENT OF DROUGHT IN THE UNITED STATES.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
N. S. Grigg.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 303-312. 1 tab, 16 ref.

Descriptors: *Drought, *Planning, *Water management, *Water supply, Decision making, Risk assessment, Water resources management, Water shortage.

Awareness of drought problems in the U.S. has risen in recent years, but effective water system planning and operations for drought conditions are impeded by differing expectations, definitional problems, hydrologic complexity and institutional fragmentation. Results of surveys about management of the 1986 U.S. Southeast drought and about the use of risk analysis by water purveyors are reported. In spite of meteorological and hydrologic advances, use of information technologies and risk-based decision making lags among water management practitioners. Improved support and use of data and models is needed to manage future droughts in the U.S. (See also W91-00961) (Author's abstract)
W91-00991

DROUGHTS AND FLOODS: THEIR DEFINITION AND MODELING.
Politechnika Warszawska (Poland). Inst. of Environmental Engineering.
M. Ozga-Zielinska.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 313-322. 4 fig, 14 ref.

Descriptors: *Drought, *Drought forecasting, *Flood flow, *Flood forecasting, *Floods, *Hydrological models, *Model studies, *River flow, *Statistical models, Differential equations, Flow equations, Surface-groundwater relations, Water table.

The notions of drought and flood were used to interpret the situation in the river concerning its flow rate. They do not have any precise definition based on the physics of the flow phenomena. The conventional definitions of drought and flood, their characteristics and statistical methods of their computing and forecasting are discussed, along with some physical based approaches to modeling river flow. A catchment is described as a dynamic system with two sub-systems, i.e. surface and groundwater sub-systems. Each of them is separately described by the input-output relationship in the form of an ordinary linear differential equation. (See also W91-00961) (Author's abstract)
W91-00992

REGIONALIZATION OF LOW FLOW CHARACTERISTICS USING LOGISTIC AND GLS REGRESSION.
Geological Survey, Reston, VA.
G. D. Tasker.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 323-331. 1 tab, 11 ref.

Descriptors: *Flow models, *Low flow, *Model studies, *River flow, *Streamflow, Hydrologic models, Regional analysis, Regression analysis, River basins.

Two new methods are described for dealing with practical problems encountered in implementing regional regression models to predict low flow characteristics. First, to determine the probability of encountering a flow of zero at a site as a function of the basin characteristics at the site, a logistic regression was used to relate the probability of zero flow to basin characteristics. A second practical problem in regional regression arises because estimates of low flow characteristics, such as mean annual minimum flow, at stream gages are based upon records of different length or at some sites estimates may be may be based upon a relatively small number of low flow measurements rather than a complete record of flows. In addition, low flows at a site autocorrelated, resulting in an effectively shorter record. Ordinary least squares regression is not appropriate in such cases. Instead an estimated generalized least squares estimator for the regional regression model is used. This model takes into account differences in accuracy of at-site estimates of low flow characteristics, the sample cross correlation between estimates, and the sample autocorrelation of annual minimum flows. (See also W91-00961) (Author's abstract)
W91-00993

CHARACTERISTICS OF STREAMFLOW DROUGHT.
Ohio Univ., Athens. Dept. of Civil Engineering.
T. J. Chang.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 333-341. 6 fig, 2 tab, 11 ref.

Descriptors: *Drought, *Flow models, *Model studies, *Statistics, *Streamflow, Flow equations, Hydrologic models, Ohio River basin, River basins.

Assuming the nonhomogeneous Poissonian behavior of droughts, the intensity function was developed to investigate the characteristics of drought occurrences that can be used for the purpose of simulation. Based on the daily streamflows from the Ohio River Basin, it was found that drought intensities were varied depending highly on time and truncation level. The correlation coefficients between drought durations and their corresponding deficits were significantly large for all the streamflow stations studied in the basin. Such findings suggest that regional water resources management using drought series should consider modifications. (See also W91-00961) (Author's abstract)
W91-00994

DEVELOPMENT AND APPLICATION OF SIMPLE WATER BALANCE MODELS TO UNDERSTAND THE RELATIONSHIP BETWEEN CLIMATE AND WATER RESOURCES.
National Oceanic and Atmospheric Administration, Washington, DC.
For primary bibliographic entry see Field 2A.
W91-00995

DERIVING STREAM PARAMETERS FOR HYDROLOGIC MODELING FROM DIGITAL ELEVATION DATA.
Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.
K. F. Connors, T. W. Gardner, and R. L. Day.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 397-406. 4 fig, 1 tab, 13 ref.

Descriptors: *Geographic information systems, *Hydrologic models, *Model studies, *Stream profiles, *Streamflow, Digital elevation model, Errors, Maps, Stream discharge, Surface water.

The utility of a digital elevation model (DEM) to derive stream channel parameters for input to a hydrologic model, SPUR (Simulation of Production and Utilization of Rangelands) was investigated. The relationships between stream parameters (stream length and slope) and the Shreve stream order and the relationship between these stream networks and associated parameters and the prediction of surface water discharge from SPUR were examined. DEM-derived networks with different Shreve orders produced significantly different stream lengths and stream slopes but were only different from similar networks derived manually from 1:24,000 topographic maps. The most complex network produced the lowest errors in monthly runoff volume predictions. This results from the effects of increasing stream length, increasing average stream slope, and increasing number of contributing areas as stream order is decreased. The simplest stream network produced results that best matched the observed peak flow rates for low probability events. (See also W91-00961) (Author's abstract)
W91-01000

EXSRM, AN EXPERT SYSTEM FOR SNOWMELT RUNOFF MODEL (SRM).
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
E. T. Engman, A. Rango, and J. Martinec.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 417-426, 5 fig, 10 ref.

Descriptors: *Expert systems, *Hydrologic models, *Model studies, *Runoff forecasting, *Snowmelt, Computer programs, Simulation.

An expert system is being developed to assist unfamiliar users to set up and operate a complex model for simulating snowmelt runoff. The expert system encodes the procedures that experienced hydrologists use to set up input data, select parameters, and adjust these vales when initial simulations do not match measured data. The expert system is built around an existing FORTRAN model which is not changed and does not need to be reprogrammed into a different computer language. Parts of the expert system can be implemented as they are completed without affecting the model operation. Since the FORTRAN code itself is not changed, historic inputs and parameter estimations can be mixed with the inputs and parameters developed by the expert system. (See also W91-00961) (Sand-PTT)
W91-01002

USING GIS TO ASSESS SPATIAL VARIABILITY OF SCS CURVE NUMBER AT THE BASIN SCALE.
Politecnico di Milano (Italy). Inst. of Hydraulics.
M. Mancini, and R. Rosso.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 435-444, 8 fig, 5 tab, 9 ref.

Descriptors: *Geographic information systems, *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *River basins, *Storm runoff, Italy, Soil moisture retention, Soil types, Variation coefficient.

Calibration of Soil Conservation Service Curve Number (CN) is performed within a distributed framework. This is based on the detailed information from the Geographic Information System (GIS) available for Petrace basin, southern Italy. The spatial variability of CN was analyzed in terms of random field, and the effects due to aggregation of tributary areas were investigated for increasing area used for averaging. Due to the large fluctuations of CN estimates, storm runoff production was found to be highly variable within the basin. The combined effect of aggregation area and rainfall depth was analyzed. It was found that increasing rainfall depth strongly decreases surface runoff variability. On the contrary, surface runoff variability is much less sensitive to increasing aggrega-

tion area. However, the values of coefficient of variation of surface runoff production are much larger than the corresponding ones found for soil potential maximum retention and curve number, independently of rainfall depth. (See also W91-00961) (Sand-PTT)
W91-01004

2F. Groundwater

WATER SUPPLY FOR MEXICO CITY.
Universidad Autonoma Metropolitana, Mexico City. Unidad Iztapalapa.
For primary bibliographic entry see Field 3D.
W91-00020

CASCADING WATER: A THREAT TO GROUND WATER QUALITY.
For primary bibliographic entry see Field 5B.
W91-00053

THREE-DIMENSIONAL SCALE MODEL OF GROUND-WATER SOLUTE TRANSPORT.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Div. of Engineering Fundamentals.
For primary bibliographic entry see Field 5B.
W91-00064

GROUNDWATER MODELLING AS A TOOL FOR WATER MANAGEMENT: WAIMEA PLAINS, NELSON.
Nelson Catchment Board (New Zealand).
A. D. Fenemor.
Journal of Hydrology (New Zealand) JLHYAD, Vol. 28, No. 1, p 17-31, 1989. 9 fig, 11 ref.

Descriptors: *Alluvial aquifers, *Computer models, *Groundwater, *Groundwater management, *Model studies, Coastal aquifers, Finite difference methods, Flow models, New Zealand, Pumping tests, Safe yield, Saline water intrusion.

The Waimea Plains is a 7500 ha area of intensive horticulture and cropping near Nelson, New Zealand, underlain by three major alluvial aquifers. Summer drawdowns exceed 10 m near the town of Richmond, and seawater intrusion is considered possible because coastal heads are frequently drawn below sea level. A quasi three-dimensional computer model of the groundwater system of the Waimea alluvial basin was developed and calibrated. A modified version of the Trescott finite difference model, developed by the U.S. Geological Survey, was used. The aquifers were represented by three layers of 20 x 46 nodes with a uniform grid spacing of 487 m. Model parameters were derived from pumping test data, water balance accounting, and pumpage records. Both steady-state and transient calibrations were performed. Model simulations evaluated the optimal yield of the aquifers given the constraints of preventing seawater intrusion or excessive water level declines, and maintaining minimum river flows. Other simulations showed the seasonal fluctuations in head when no pumpage is occurring, and the impacts of various irrigation scheme proposals. Results of this modeling assisted the Nelson Catchment Board in formulating management policies for the water resources of the Waimea Plains restricting summer water usage. (Tappert-PTT)
W91-00075

PCG SOLUTIONS OF FLOW PROBLEMS IN RANDOM POROUS MEDIA USING MIXED FINITE ELEMENTS.
California Univ., Irvine. Dept. of Civil Engineering.
D. E. Dougherty.
Advances in Water Resources AWREDI, Vol. 13, No. 1, p 2-11, March 1990. 6 fig, 4 tab, 32 ref.

Descriptors: *Finite element method, *Groundwater movement, *Mathematical models, *Mathematical studies, *Model studies, *Numerical analysis, *Porous media, Computer models, Data interpretation, Hydraulic conductivity, Mathematical equations, Solute transport.

The preconditioned conjugate gradient (PCG) method has found wide acceptance for the solution of symmetric systems of equations, such as those that arise in groundwater flow simulations. Several heuristic preconditioners for the PCG method are examined using random hydraulic conductivity fields, because such distributions of conductivity are of practical interest in studies of solute transport and can be very difficult to solve due to the high condition number they engender. The flow problems are discretized with the mixed finite element method, the resulting matrix is reduced in size by block Gauss elimination, and PCG is applied to the resulting problem. As a result of the matrix reduction and the need to store the resultant matrix implicitly because of storage limitations for large problems, the selection of a preconditioner is not obvious. Four heuristic preconditioners, selected because of the simplicity with which they can be constructed from the implicit matrix representations and because of their potential for high performance computers, are tested: diagonal, tridiagonal, scaled diagonal, and scaled tridiagonal. Tests were performed on fields with random hydraulic conductivity, both isotropic and anisotropic correlation functions, and a large range of standard deviations. The scaled tridiagonal and diagonal preconditioners prove very effective and efficient for a broad range of problems, even for conductivity variations of 25 orders of magnitude. (Author's abstract)
W91-00117

THEORY OF SUBSURFACE WATER-BORNE SOLUTE TRANSPORT.
Australian Nuclear Science and Technology Organisation, Sutherland. Environmental Science Div.
For primary bibliographic entry see Field 5B.
W91-00119

NUMERICAL MODEL FOR AREAL MIGRATION OF WATER AND LIGHT HYDROCARBON IN UNCONFINED AQUIFERS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 5B.
W91-00120

SIMULATION OF DISPERSION IN LAYERED COASTAL AQUIFER SYSTEMS.
Geological Survey, Reston, VA. Water Resources Div.
T. E. Reilly.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 211-228, May 1990. 9 fig, 10 ref.

Descriptors: *Coastal aquifers, *Dispersion, *Groundwater movement, *Mathematical models, *Saline water intrusion, *Saline-freshwater interfaces, *Simulation analysis, Confining units, Density stratification, Fluid mechanics, Hydrodynamics, Seawater, Solute transport, Transition zone, Water circulation.

Freshwater-saltwater transition zones in coastal aquifers in equilibrium are subject to constant circulation of seawater because of hydrodynamic dispersion. This movement of seawater may be subtle, but it is observed in field studies and is important in describing the saltwater-freshwater transition zone. To simulate the dispersed nature of the saltwater-freshwater interface and the associated saltwater circulation zones, it is necessary to consider the problem as a density-dependent miscible-solute-transport problem. The transport mechanism of hydrodynamic dispersion attempts to account for fluid movement due to velocity variations that cannot be measured or simulated. In layered coastal systems, the scale of horizontal movement is usually very different from the scale of movement through confining units. This requires that dispersivities used to describe the system under investigation reflect the difference in scale. This formulation was used to examine groundwater flow in layered coastal aquifers. The numerical experiments indicate that although the transition zone may be thought of as an impermeable 'sharp' interface with freshwater flow parallel to the transition zone in homogeneous aquifers, this is not the case for layered systems. Freshwater can discharge through the transition zone in the confining units. Further, for the best simulation of layered coastal aquifer systems, either a flow-direction-dependent dispersion formulation is required, or the dispersivities must change spatially to reflect the tight thin confining unit. (Fish-PTT)
W91-00155

EVALUATION OF HYDROGEOCHEMICAL PARAMETERS WITH SPONTANEOUS POTENTIAL LOGS.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 7B.
W91-00157

SOME FUNDAMENTAL WEAK SPOTS OF KRIGING TECHNIQUE AND THEIR CONSEQUENCES.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Soil and Groundwater.
For primary bibliographic entry see Field 7C.
W91-00159

ESTIMATING GROUNDWATER RECHARGE USING A SURFACE WATERSHED MODELLING APPROACH.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
F. H. S. Chiew, and T. A. McMahon.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 285-304, May 1990. 10 fig, 6 tab, 15 ref.

Descriptors: *Groundwater management, *Groundwater recharge, *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *Surface-groundwater relations, Australia, Evapotranspiration, Irrigation, Streamflow data, Watersheds.

Groundwater level predictions are required to evaluate management options for groundwater control, particularly in salt-affected lands. To provide realistic long-term predictions, good estimates of recharge based upon physical processes are necessary. A surface watershed modeling approach, the daily version of the rainfall-runoff model HYDROLOG, was used as the surface model with potential evapotranspiration estimated from Morton's representation of wet environment evapotranspiration. The surface model was calibrated and tested by comparing the streamflow simulated by the model and the recorded streamflow. Groundwater recharge is an output from the model. Modeling was carried out in both the irrigated and non-irrigated areas of the northern half of the Campaspe River Basin in northern Victoria, Australia. It was concluded that this approach is promising as the model was able to simulate fluctuations in the recharge rates. The model predicted higher recharge in the spring-winter months compared with the summer-autumn months. This is expected as rainfall is higher in the spring-winter months. The model predicted higher recharge in the southern parts of the catchment. This is also expected as rainfall is much higher in the south and the soils there are more sandy. The model was also able to detect recharge caused by irrigation. However, modeling of the irrigated areas in a similar way to the non-irrigated areas may not be appropriate. As a result, the recharge estimates in the irrigated areas should be used with caution. (See also W91-00161) (Fish-PTT)
W91-00160

SPATIALLY CONTINUOUS DETERMINATION OF GROUNDWATER FLOW TO SURFACE WATER BODIES: APPLICATION TO THE CONNECTING CHANNELS BETWEEN LAKES HURON AND ERIE.
Wisconsin Univ.-Milwaukee. Dept. of Geosciences.
For primary bibliographic entry see Field 2A.
W91-00163

HYDROCHEMICAL CHARACTERIZATION OF GROUNDWATER MIXING IN SEDIMENTARY AND METAMORPHIC RESERVOIRS WITH COMBINED USE OF PIPER'S PRINCIPLE AND FACTOR ANALYSIS.
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
For primary bibliographic entry see Field 2K.
W91-00164

USING ISOTOPE FRACTIONATION OF NITRATE-NITROGEN AND NITRATE-OXYGEN FOR EVALUATION OF MICROBIAL DENITRIFICATION IN A SANDY AQUIFER.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W91-00166

REMOTE-SENSING APPLICATION TO WELL MONITORING.
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih, and J. D. Jordan.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 497-507, July/August 1990. 5 fig, 2 tab, 14 ref.

Descriptors: *Flowing wells, *Infrared imagery, *Monitoring wells, *Remote sensing, *Saline water intrusion, Aerial photography, Artesian wells, Data acquisition, Data interpretation, Reflectance techniques, Spectral analysis, Spectrophotometry, Vegetation.

The artesian wells flowing uncontrolled in many parts of Florida have caused a serious saline-contamination problem. Locating these wells by ground search is made difficult by the urbanized or reforested condition of formerly agricultural land. Both ground-based color infrared (GCIR) and aerial color infrared (ACIR) photographs were taken for analysis of the spectral reflectance of land-surface features that can provide information for detection of flowing wells. Both GCIR and ACIR showed similar patterns of spectral reflectance for the same component class of land-surface features. Well-site soil had higher spectral reflectance than soil not associated with a well. Well water had higher spectral reflectance than natural pond and ditch water. The spectral reflectance patterns of vegetation types studied all have two peak-intensity values. The vegetation types had differences in spectral reflectance magnitude except for leather fern and cattail (similar to each other) and St. Augustine grass and cucumber (also similar to each other). The combination of green and red channels of spectral reflectance video-digitized from ACIR photography appears to be useful for classifying landcover types and distinguishing flowing wells. (Author's abstract)
W91-00169

UNSTEADY DRAWDOWN OF WATER TABLE.
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
M. E. Savci.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 508-526, July/August 1990. 19 fig, 1 tab, 13 ref.

Descriptors: *Drawdown, *Groundwater level, *Groundwater movement, *Mathematical models, *Model studies, *Water table fluctuations, *Water table gradient, Drainage ditches, Drainage engineering, Numerical analysis, Reservoirs, Unsteady flow, Water table profiles.

Unsteady water table drawdown problems have either theoretically or experimentally been studied for many years. Equations have been developed to predict water table geometry for flow toward a drainage ditch or reservoir whose water surface level is subject to a sudden specified drop. A closed function representing the water table geometry is obtained for the classical potential formulation of the problem under initial and boundary conditions related by means of a perturbation method. The first order term of this closed function is identical to the previously published solutions. The inclusion of the second and third order terms improved the accuracy considerably. The water table profile found as a function of only one variable is predicted for various power series parameter values, ranging between -1 and 0. Temporal and spatial variations of the water table were obtained for various power series parameter values. The comparison of the present results with those of previous works shows good agreement. (Fish-PTT)
W91-00170

APPROPRIATE METHODOLOGIES FOR DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES IN DEVELOPING COUNTRIES. VOLUME I.
For primary bibliographic entry see Field 4B.
W91-00215

PUMPING TEST IN A LOW PERMEABILITY CLAYSTONE AQUIFER EXECUTED WITH HIGH-RESOLUTION ELECTRONIC WATER LEVEL RECORDERS AND EVALUATED WITH THE VERSATILE COMPUTER PROGRAM HYDROPAR.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
K. Trippler.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 3-14, 3 fig, 2 tab, 4 ref.

Descriptors: *Aquifer testing, *Aquifers, *Computer programs, *Data interpretation, *Groundwater movement, *Permeability, *Pumping tests, Clays, Data acquisition, Hydraulic conductivity, Observation wells, Water supply, West Germany.

A long duration pumping test was carried out in October 1983 west of Hannover, West Germany, in a low permeability, highly fractured claystone aquifer system. Groundwater was pumped continuously for 120 hours (0.96 cu m/hr) from one well. The drawdown was automatically measured in 13 observation wells with high-resolution ultrasonic transducers which functioned as both a transmitter and receiver. The data are stored on magnetic tape and the data can be processed directly by computer using the versatile program HYDROPAR. Results from this pump test showed that the aquifer is semiconfined (S=0.001) and has a low transmissivity (T=0.21 sq m/hr). The results confirm that the test was carried out in a semiconfined aquifer system of low to medium hydraulic conductivity. In arid and semi-arid areas such an aquifer can be used for domestic water supply. (See also W91-00215) (Lantz-PTT)
W91-00216

ANALYSIS OF PUMPING TEST DATA FROM BOREWELLS IN FRACTURED ROCKS OF KARNATAKA.
Roorkee Univ. (India). Dept. of Earth Sciences.
S. K. Mishra, B. B. Singhal, and D. C. Singhal.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 15-25, 2 fig, 3 tab, 15 ref.

Descriptors: *Aquifer testing, *Boreholes, *Data interpretation, *Geologic fractures, *Groundwater movement, *Mathematical analysis, *Pumping tests, Flow pattern, Geohydrology, Mathematical equations, Mathematical studies, Porosity.

Aquifer characteristics and well characteristics were computed from data of pumping tests conducted in the Northern parts of Karnataka. An attempt was made to compute aquifer characteristics using a double porosity model. The time-drawdown curves match to a greater extent with the type curves for a double porosity model and results computed are consistent with the field observations. It is concluded that the flow in fractured formations is complex. The use of Rorabaugh's method for well characteristics in fractured formations discriminates between the laminar, turbulent, and transitional nature of flows. The specific drawdown versus discharge plots help to better understand the flow patterns in fractured formations. (See also W91-00215) (Lantz-PTT)
W91-00217

ANALYSIS OF TEST PUMPING DATA FROM UNCONFINED AQUIFERS BY SIMULATION.
Roorkee Univ. (India). School of Hydrology.
D. Kashyap, P. K. Sarkar, and A. M. Khaled.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 27-35, 2 fig, 3 tab, 7 ref.

Descriptors: *Aquifers, *Data interpretation, *Groundwater movement, *Mathematical analysis, *Pumping tests, *Simulation analysis, Case studies, Drawdown, Groundwater budget, Groundwater mining, India, Mathematical studies, Observation wells, Specific yield, Transmissivity, Vertical flow.

The application of Neuman's theory coupled with the principle of superposition is suggested for analyzing test pumping data from unconfined aquifers. The procedure involves repeated intelligent guesses of the parameters until a close enough match between the observed and the computed time-drawdown curves is obtained. Such an analysis can account for the partial penetration of wells and extra intermittent pumpings from the aquifer. The estimated parameters include: storage coefficient, specific yield, transmissivity and vertical anisotropy. A case study includes a pumping test of 5760 minutes duration conducted on unconfined aquifer at Khajuri-Akbarpur, India. The discharge from the pumping well was 4620 cu m/day and drawdowns were monitored in two observation wells. The pumping well was fully penetrating and the observation wells were partially penetrating. The time drawdown data reveal that the drawdowns displayed declining trends between 500-900 minutes and 2400 and 4000 minutes. The phenomenon occurred in both the observation wells causing sudden kinks in the time drawdown curves. Results of the case study suggest that a procedure for test pumping analysis may account for time variant test pumping discharge, uncontrolled pumpings, and partial penetration of wells provided that adequate data are recorded during the test. (See also W91-00215) (Lantz-PTT)
W91-00218

CRITICAL EVALUATION OF PUMPING TEST DATA FROM FRACTURED CRYSTALLINE FORMATION.
Madras Univ. (India). Dept. of Applied Geology.
P. N. Ballukraya, R. Sakthvadivel, and B. R. Reddi.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 37-45, 7 fig, 1 tab, 8 ref.

Descriptors: *Aquifers, *Crystalline rocks, *Data interpretation, *Geologic fractures, *Groundwater movement, *Pumping tests, Boreholes, Drawdown, Groundwater budget, Hydraulic conductivity, Transmissivity.

Conventional methods for the estimation of aquifer parameters often pose difficulties when applied to pumping test data from borewells in crystalline rock aquifers. The time-drawdown curves obtained from pumping and observation wells reflect the variation in hydraulic conductivity both in space and direction. Formation of segments in the time-drawdown need not necessarily be due to barrier boundaries as has been observed in alluvial aquifers, but may be the effect of varying hydraulic conditions in the aquifer itself with respect to pumping time. A multiple pumping test carried out in a crystalline formation was analyzed leading to the conclusion that the data from the pumping well

itself is a better indicator of transmissivity characteristics than observation wells, and that they can be estimated more accurately using a numerical method than by conventional methods. (See also W91-00215) (Author's abstract)
W91-00219

COMPUTATION OF TRANSMISSIVITY FROM STEP-DRAWDOWN TESTS.
Action for Food Production (AFPRO), Geohydrological Investigation Team, Hyderabad-500 007.
M. Srinivas.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 47-58, 4 fig, 4 tab, 4 ref, append.

Descriptors: *Aquifer testing, *Drawdown, *Groundwater management, *Pumping tests, *Transmissivity, Computer programs, Data interpretation, Groundwater budget, Mathematical equations.

The main drawback in transmissivity computations from step-drawdown test data is a significant well-loss component. A method is suggested for estimating the transmissivity from pumped data of step-drawdown tests. Employing Jacob's method of analysis, well losses are computed and corrected for in the drawdown values for each step. The corrected drawdowns are used in Logan's formula after being modified. Logan's formula uses maximum drawdown values and the resulting transmissivity values were erroneous up to 50% or more. They compared very well with each other as with the transmissivity values computed from long-duration test data. A computer program in FORTRAN is also given for complete analysis and results from inputting just the field data. This method is considered cost effective and time saving. (See also W91-00215) (Lantz-PTT)
W91-00220

RURAL WATER SUPPLY INVESTIGATIONS IN SCARCITY VILLAGES IN BHANDARA DISTRICT, MAHARASHTRA.
Central Ground Water Board, Nagpur (India). Central Region.
For primary bibliographic entry see Field 7B.
W91-00222

APPLICATION OF RADIOACTIVE TRACER TECHNIQUES FOR DETERMINING GROUNDWATER VELOCITY AND DIRECTION.
Bhabha Atomic Research Centre, Bombay (India).
For primary bibliographic entry see Field 7B.
W91-00223

ENVIRONMENTAL ISOTOPE-AIDED STUDIES ON WATER RESOURCES IN THE REGION OF CHEJU ISLAND.
Korea Advanced Energy Research Inst., Daeduk (Republic of Korea).
J. S. Ahn, J. W. Kim, J. H. Kim, Z. K. U, and C. C. Chong.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 89-98, 5 fig, 8 tab, 18 ref.

Descriptors: *Cheju Island, *Groundwater quality, *Groundwater resources, *Radioactive tracers, *Saline water intrusion, *Tracers, Acids, Bases, Deuterium, Groundwater budget, Tritium, Well yield.

The groundwaters yielded from existing deep wells situated within 2 km from the coast-line in the U-do and Songsan areas of Korea and classified as category 7, that is primarily saline dominated by alkalies and strong acids, such as saline water. The chlorine content of the groundwater ranges from about 200 ppm to 600 ppm. Tritium, deuterium, and oxygen-18 contents of seawater are 5.74 +/- 0.2 ppt in maximum, and 8.67 +/-0.45 TU, -24 +/-0.18 ppt, -3.6 + 0.12 ppt in case of rainwater, and 15.11 +/-0.61 TU, -43.4 +/-1.12 ppt, -7.2 +/- 0.5 ppt in case of pure and non-affected groundwater by saltwater encroachment. Groundwater bodies that are highly effected by saltwater intrusion are characterized by a content of tritium that is similar to that of non-affected groundwater. (See also W91-00215) (Lantz-PTT)
W91-00224

GROUNDWATER RECHARGE ESTIMATION BY TRITIUM TRACER TECHNIQUE IN SATHUPALLY AREA, ANDHRA PRADESH, INDIA.
Osmania Univ., Hyderabad (India). Dept. of Geology.
C. Sudarsana Raju, C. S. Murti, and M. A. Haleem.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 99-108, 2 fig, 1 tab, 6 ref.

Descriptors: *Groundwater recharge, *India, *Radioactive tracers, *Sathupally, *Tracers, *Tritium, Geohydrology, Gneiss, Groundwater budget, Sandstones.

Geohydrological studies were carried out in the Sathupally area of Godavari Valley, A.P., India. The geological formations present in the area include Archean gneisses and Kamti sandstone. Recently there has been an influx in the use of groundwater resources in the region. During the 1985-86 hydrological cycle, groundwater recharge was measured in the 517 sq km Tammileru River basin in Sathupally. Twenty-five sites were injected with 4 ml of 200 microCi-tritiated water at a depth of 80 cm below ground level. This injection took place in the first week of 1985 prior to the onset of the southwest monsoon. Observations indicated that the depth of recharge varied (using the piston flow model) from -9 cm to +24 cm among the 25 sites. The values were found to be positive in the recharge area and negative in the discharge portion of the basin. Average recharge depth was found to be 6.4 cm. During the 1985-86 monsoon, total groundwater recharge into the basin reservoir was estimated to be 33 cu mm. (See also W91-00215) (Lantz-PTT)
W91-00225

ENVIRONMENTAL CHLORIDE METHOD FOR GROUNDWATER RECHARGE STUDIES: POTENTIALITIES AND LIMITATIONS.
National Geophysical Research Inst., Hyderabad (India).
B. S. Sukhija, P. Nagabhushanam, and D. V. Reddy.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 109-118, 2 fig, 6 ref.

Descriptors: *Chlorides, *Geochemistry, *Groundwater budget, *Groundwater movement, *Groundwater recharge, *Tracers, Hydrologic budget, Rainfall-runoff relationships, Soil water.

A study of groundwater recharge is a basic requirement in any water balance study. The application of environmental and other isotope tracer techniques for such purpose has been demonstrated by many workers in different hydrologic regimes. Chloride has only been recently used as a simple geochemical tracer. The potential use and limitation of environmental chloride for estimating groundwater discharge is addressed. Currently, there are two methodologies used for evaluation: (1) using the chloride concentration of groundwater and soil water, and (2) comparing the input with actual chloride content. Another method that is used compares soil profiles where the total deposition of chloride is studied. Average chloride concentration can be related to long-term recharge and chloride concentration in rainfall based on the chloride balance. Recent chloride studies have shown the mechanism of recharge and the environmental hazards that are a result of deforestation. Environmental chloride is a simple geochemical tracer with great potential for use in environmental studies. (See also W91-00215) (Lantz-PTT)
W91-00226

SPECIFIC YIELD ESTIMATIONS BY RADIOACTIVE TRACER IN INDO-GANGETIC PLAIN.
Uttar Pradesh Irrigation Research Inst. Roorkee (India).
R. K. Raja, S. N. Rawat, and S. S. Chhabra.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 119-130, 5 fig, 5 tab, 5 ref.

Descriptors: *Groundwater resources, *India, *Radioactive tracers, *Specific yield, *Tracers, *Well yield, Aquifers, Developing countries, Geohydrology, Groundwater budget, Pumping tests.

Specific yield is an important geohydrological parameter of an aquifer when determining changes in groundwater storage. Due to the variability of alluvial material, the evaluation of specific yield has long been recognized to be subject to large inaccuracies, and is usually determined by laboratory or field measurements. Both types of measurements have distinct limitations and practical difficulties. Tracer techniques provide a comparatively better alternative, provide a more reliable results of specific yield and assessment of aquifers. A field study was carried out to estimate the specific yield at Devla (District Saharanpur), Rampur (District Bijnor), Biralsi (District Muzaffarnagar), Badaut (District Meerut), and Chharra (District Aligarh) lying in the Indo-Gangetic plain of Western Uttar Pradesh, India, using tritium as a radioactive tracer. Pump test and grain size analysis methods have also been carried out to compare the results obtained by tracer techniques at the same test sites. The study indicates that the specific yield values obtained by the tracer method vary from 8.18% to 23.48%; it varies from 7.40% to 23.23% by pump test for the shallow unconfined aquifer in five districts of the Indo-Gangetic Plain. The tracer technique gives a fairly acceptable value for specific yield, and the results are in close agreement with those obtained by the pump test method. They differ, however, with the results obtained through grain size analysis. (See also W91-00215) (Lantz-PTT)
W91-00227

JOINT SYSTEM ANALYSIS FOR THE EVALUATION OF FLOW IN FRACTURED AQUIFER.
Central Ground Water Board, Bhubaneswar (India).
For primary bibliographic entry see Field 7C.
W91-00228

USE OF SINGLE WELL DILUTION TECHNIQUE FOR SEEPAGE MEASUREMENTS FROM CANALS USING RADIO-ACTIVE TRACER.
Uttar Pradesh Irrigation Research Inst. Roorkee (India).
A. N. Bhargava, P. R. Singh, and S. S. Chhabra.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 155-166, 5 fig, 3 tab, 5 ref.

Descriptors: *Canals, *Groundwater recharge, *Radioactive tracers, *Seepage, *Surface-groundwater relations, *Tracers, Deoband Canal, Flow velocity, Groundwater movement, India, Mathematical studies, Permeability, Upper Ganga Canal.

The height of a water column in a borehole at different distances from a canal bank plays an important role in determining the subsurface flow of water from canals. In the past investigators did not consider this factor when evaluating the seepage velocity by the single well dilution technique. A field study has been carried out by from various sections along several earthen canals of Uttar Pradesh using a radioactive tracer. The variation of the tracer dilution velocity with parameters related to the canal and borehole were studied. Once the seepage velocity was known, the seepage loss from the canals, using the single well dilution technique, was estimated through a mathematical process. The results of the seepage loss at the test sites in the Upper Ganga Canal were 1.83 and 2.16 cu m/sec/million cu m of wetted surface for the Deoband Canal. (See also W91-00215) (Lantz-PTT)
W91-00230

APPROACH IN DETERMINATION OF AQUIFER GEOMETRY AND ESTIMATION OF AQUIFER PARAMETERS OF AN AREALLY EXTENSIVE UPPER KAMTHI SANDSTONE AQUIFER IN PARTS OF GODAVARI VALLEY, ANDHRA PRADESH.
M. Veeranna, and K. V. J. R. Krupanidhi.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 167-169.

Descriptors: *Aquifers, *Artesian aquifers, *Geohydrology, *Geologic units, *Groundwater movement, Geologic fractures, Hydraulic properties, Wells.

The Godwana basin of the Godavari Valley in Andhra Padesh, India, is comprised of sandstone, clay, and siltstone striking a NW-SE direction with a dip toward the NE. The formations are traversed by numerous faults. This has become a problem with regard to deciphering the depth, thickness and extent of aquifers in view of the sloping and disturbed strata. The lithological and electrical logs of Yedlapalli and Koyyuru boreholes have indicated occurrence and extension of the potential confined Upper Kamthi Aquifer. The observation at Yedlapalli have shown the presence of hydraulic continuity in this artesian aquifer, although it is associated with structural disturbances. It has also helped in deciphering the location of negative boundaries beyond the Koyyuru well field but not in between the Koyyuru and Yedlapalli well fields. In such situations a planned construction of small diameter observation wells at distances of 4 to 5 km would help in understanding the aquifer geometry and estimating the aquifer parameters in the region. This would save construction and testing costs for conventional well fields. (See also W91-00215) (Lantz-PTT)
W91-00231

SUBMERSIBLE PUMP TESTS CONDUCTED ON BORES DRILLED BY D.T.H. COMPRESSOR RIGS AND THE COMPARISON OF TWO DISCHARGES.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
A. J. Merh, and K. H. Chatrola.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 171-173.

Descriptors: *Geohydrology, *Groundwater movement, *Pumping tests, Boreholes, Case studies, Pumps, Wells.

The shortage of drinking water from 1986-1988 in Gujarat State, India posed a challenge to geohydrologists in locating a suitable site for a borehole in basaltic terrain. Drilling was done by D.T.H. compressor rigs making 150mm diameter boreholes. Discharges were measured by 90 degree V notch methods. A goal of a minimum of 1 L/s discharge was considered suitable for a submersible pump. A comparison between two discharges shows that out of 21 cases 13 had an increase in discharge when the boreholes were pumped. In four of the cases there was no change and in four other cases there was a decrease in discharge. The decrease may be due to the time gap between drilling and test pumping. Six cases prompted the use of submersible pumps; five deep well pumps were recommended and six hand pumps were suggested. In four of the cases the discharge obtained was not significant. (See also W91-00215) (Lantz-PTT)
W91-00232

AQUIFER PARAMETER ESTIMATION AND GROUNDWATER POTENTIALITY IN GRANITE-BASALT TERRAIN NEAR HYDERABAD, INDIA.
Osmania Univ., Hyderabad (India). Dept. of Geology.
C. Sudarsana, and M. Muralidhar.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 175-178, 4 fig, 1 tab, 5 ref.

Descriptors: *Aquifers, *Geohydrology, *Groundwater budget, *Groundwater resources, *India, Developing countries, Hyderabad, Mathematical equations, Water resources development.

The area under investigation is 200 sq km to the southwest of Sadasivpet at the contact between the Peninsular granite and Deccan basalts near Hyderabad, India. The region is well drained and most of the agricultural and domestic water demands are met by groundwater. There is still room for further groundwater development, determined from field and aquifer studies that indicate that the area has vast untapped groundwater potential. Considering the local geohydrological factors, exploitation of groundwater reserves should be attempted. Specific Capacity (C) of the wells is determined by Slitcher's formula. The C values range from 19 to 102 L/min/m and in one case is 207 and in another 639. Formation-wise, there is no distinct difference in the C values, but to have uniformity the unit area specific capacities of the wells are calculated. They vary from 0.5 L/min/sq m to 2.39 L/m/sq m. (See also W91-00215) (Lantz-PTT)
W91-00233

INSTRUMENTATION AND TECHNIQUE OF GROUNDWATER EXPLORATION (WITH NATURE OF AQUIFER) IN UNCONSOLIDATED SEDIMENTS (GANGETIC PLAINS) OF UTTAR PRADESH, NORTHERN INDIA.
Lucknow Univ. (India). Dept. of Geology.
A. C. Nautiyal.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 183-193, 5 fig, 14 ref.

Descriptors: *Data acquisition, *Drilling, *Groundwater resources, *Uttar Pradesh, *Water resources development, Aquifers, Drills, Groundwater budget, Hydraulic machinery, India, Pumps, Sand.

In the Gangetic Plains of Uttar Pradesh, India, the rotary rigs (RR) are used for drilling underground water wells. Subsequently, the drilled hole is lined with a steel pipe to a depth of 45.60 m. From this depth, the well is screened to a depth of 130 m. A filter pack is poured into the annular space between the aquifer and the screen. The filter retains the aquifer particles outside its outer boundary and the screen slot size is chosen to prevent the filter pack itself from passing through the slots. An electric-submersible pump (with five impellers) is placed inside a steel pipe, surrounded by a housing pipe, at a depth of about 33.44 m, being submerged within the shallowest first aquifer zone (between 24.32 m and 33. 44 m depth). A good number of shallow wells drilled in the Gangetic alluvial plains commonly revealed sandy aquifers of high potentiality of yielding groundwater. Two such wells drilled in southeastern Lucknow's alluvial plains revealed distinct inter-layering of soft clay (grayish yellow), sand (light gray to light olive gray), clay and kankar (yellowish gray), clay with kankar and sandy fragments (very light gray with yellowish tinge), and four sandy unconfined aquifers (each 9 m thick) horizons (sands being yellowish gray to very light gray, fine grained, winnowed) were located, with these sediments collectively called Bhangar in the Ganges valley of northern India. (See also W91-00215) (Lantz-PTT)
W91-00235

PARAMETER ESTIMATION FOR A QUASI-THREE-DIMENSIONAL FLOW MODEL.
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 7C.
W91-00236

INVESTIGATIONS OF GROUNDWATER RESOURCES AT SELECTED LEVELS IN DROUGHTPRONE AREA OF PAHARI BLOCK, DISTRICT MIRZAPUR, U.P., INDIA.
Banaras Hindu Univ., Varanasi (India). Dept. of Geophysics.
G. S. Yadav, and T. Lal.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 209-219, 4 fig, 7 ref.

Descriptors: *Data interpretation, *Electrical studies, *Geohydrology, *Geophysical surveys, *Groundwater resources, *India, *Resistivity, *Vertical electric sounding, Aquifers, Data acquisition, Groundwater budget, Pahari, Water resources development.

Vertical Electrical Sounding was carried out at 28 locations using the Schlumberger configuration for the investigation of groundwater resources in drought prone areas in Pahari Block, District Mirzapur, U.P. The data were interpreted by partial curve matching and Automatic Iterative Methods of Resistivity Sounding Interpretation (AIMRESI). Based on the results of the investigation, three vertical geoelectrical cross-sections representing the base of the alluvial cover, i.e. Vindhyan sandstone exposed in the central parts of the area, and the distribution of groundwater resources along the respective profiles are presented. Its depthwise areal distribution throughout the region under study is presented in four horizontal geoelectrical cross-sections at selected levels. Apart from these sections, a depth contour map is also presented showing the variations of thickness of alluvial cover and fractured sandstones on the top of the resistant substratum. Geohydrological conditions present a complex picture, especially with lithological variations of the alluvial cover derived mainly from Vindhyan sediments. The study indicates that the exploitable groundwater is mainly confined to the sandy layers and the sandy clayey layers in the northern parts of the area under investigation, while in the south-central region the groundwater is confined only to the fractured rocks of Vindhyan sandstone. (See also W91-00215) (Author's abstract)
W91-00237

MORE ACCURATE DETERMINATION OF AQUIFER PARAMETERS USING THE IP SOUNDING METHOD.
University of Science, Penang (Malaysia).
For primary bibliographic entry see Field 7B.
W91-00238

INTEGRATED GEOLOGICAL AND GEOPHYSICAL INVESTIGATIONS FOR DELINEATING KARSTIC ZONES IN CARBONATE FORMATIONS OF ANANTAPUR DISTRICT, A.P., INDIA.
National Geophysical Research Inst., Hyderabad (India).
T. Shibasaki, T. Venkataswara Rao, B.

Venkatanarayana, C. P. Gupta, and S. Sankaran.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 229-237, 4 fig, 7 ref.

Descriptors: *Geohydrology, *Geology, *Geophysical surveys, *Geophysics, *India, *Karst, *Karst hydrology, Anantapur, Carbonate rocks, Groundwater budget.

Detailed geological and geoelectrical investigations were carried out to understand the process of karstification in lower Cuddapah carbonate rocks of proterozoic age at Chillavaripalle, Anantapur district, Andhra Pradesh, India. The term karst indicates a specific morphological feature developed in carbonate rocks and is synonymous with cavernous conditions in limestone formations. The geological studies revealed the presence of a few shear and fault zones. Geomorphological observations helped identify a few horizontal cavernous zones occurring at different levels above the present river bed. Regional and detailed geoelectrical sounding and profiling indicated the presence of cavernous zones at shallow depths with a good groundwater potential. A borewell drilled at one of the identified subsurface cavernous zones showed a high groundwater yield of 50,000 L/min. The eustatic which occurred during the Quaternary period in several parts of the world might have played a significant role in the karstification of these carbonate rocks. (See also W91-00215) (Lantz-PTT)
W91-00239

HYDROGEOLOGICAL STUDY OF LATERITE AT A REPRESENTATIVE DAM SITE IN MALVAN VALLEY OF KONKAN REGION (MAHARASHTRA-INDIA) USING SEISMIC REFRACTION METHOD.
Central Water and Power Research Station, Poona (India).
A. Ansari, and B. S. Shrotri.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 239-248, 3 fig, 1 tab, 4 ref.

Descriptors: *Geohydrology, *India, *Seepage control, *Seismic properties, *Seismic surveys, *Water storage, *Water supply development, Laterites, Malvan Valley, Porosity.

The Konkan region in Maharashtra State comprises a 400 km long by 50 to 100 km wide belt along the west coast of India, south of Bombay. This region is largely covered by laterite, which is known for its high permeability. Due to this high permeability, most of the rainfall (approximately 200 cm/yr) drains into the Arabian Sea. Hence, there is a need to design appropriate water storage schemes. The peculiar cellular structure of the laterite cap is considered favorable for increasing the effective porosity of the formation. The cap acts as a conduit for vertical and/or horizontal movement of seepage water. From a seismic refraction survey conducted at Poip Dam, it is concluded that providing a positive cut-off would be an impractical proposition (Bedrock being 14-18 m deep). Therefore, clay blanketing is suggested in the reservoir area to prevent and/or reduce the entry of water through the laterite. (See also W91-00215) (Lantz-PTT)
W91-00240

BOREHOLE GEOPHYSICAL LOGGING TECHNIQUES FOR DELINEATING FRACTURED ZONES AND CAVITIES IN HARD ROCK AREAS FOR HYDROFRACTURING: A CASE STUDY.
H. N. Parikh, V. V. Ayachit, N. C. V. N. Chakravarthy, and R. K. Garg.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 249-262, 6 fig, 2 tab, 3 ref.

Descriptors: *Borehole geophysics, *Boreholes, *Case studies, *Geologic fractures, *Geophysics, *Groundwater resources, *Hydrofracturing, *Well development, Logging(Recording), Resistivity, Water resources development.

During severe scarcity conditions in the Saurashtra region of Gujarat State, deep drilling was taken up to explore the deeper aquifers in the Deccan trap formation. In some bores the yields were small and it was decided to attempt hydrofracturing in the weak fractured and jointed zones and cavities by delineating them using borehole geophysical logging techniques. Based on a study in the Deccan trap formation the following conclusions were made: (1) Correlation of lithological data with resistivity logs has indicated predominantly low resistive layers amid the high resistivity layers, which are likely to be promising for exploitation through hydrofracturing; (2) Caliper logs of these bores, which normally indicate the well diameter, clearly demarcated weak zones in the bore for further exploitation; and (3) Resistivity and caliper logs have shown a lot of coherence in delineating layers suitable for exploitation by hydrofracturing for better yields. (See also W91-00215) (Lantz-PTT)
W91-00241

HYDROGEOPHYSICAL STUDIES FOR CHARACTERIZING THE CRYSTALLINE AQUIFERS OF TAMBRAPARNI BASIN, TAMIL NADU, INDIA.
V.O.C. Coll., Tuticorin (India). Dept. of Geology.
A. Balasubramanian, K. K. Sharma, and J. C. V. Sastri.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 263-268, 3 fig, 1 tab, 12 ref.

Descriptors: *Aquifers, *Geohydrology, *Geophysical surveys, *Geophysics, *Groundwater resources, *India, *Resistivity, *Vertical electric sounding, Conductivity, Crystalline rocks, Electrical properties, Groundwater budget, Hydraulic conductivity, Porosity.

A geohydrophysical approach for deriving the empirical relationships between electrical resistivity measurements and aquifer parameters can also provide a means for solving many groundwater problems in hard rock terrain. The usefulness of vertical electrical sounding (VES) is evaluated for determining the hydrologic characteristics of crystalline aquifers in southern Tamilandu. VES are widely used in groundwater investigations and sometimes can replace test drilling. The measurements of aquifer resistivity are intuitively attractive for estimating aquifer hydraulic conductivity because of the fundamental relationship between hydraulic and electrical conductivity through their dependance on tortuosity and porosity. Most of the applications of resistivity sounding are on a qualitative basis. Quantitative work has been limited to the application of these measurements for determining the empirical relationships between aquifer resistivity, formation factors, and hydraulic conductivity in a specific aquifer. A combination of field geophysical measurements, drilled hole details, aquifer tests and water quality studies can provide the most valuable solutions for predicting aquifer properties on a regional scale. (See also W91-00215) (Lantz-PTT)
W91-00242

DECIPHERING GROUNDWATER USING REMOTE SENSING TECHNIQUES.
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W91-00243

PROSPECTING GROUNDWATER IN PUSHKAR LAKE REGION THROUGH REMOTE SENSING - A CASE STUDY.
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W91-00244

KRIGED ESTIMATES OF WATER-LEVELS FROM THE SPARSE MEASUREMENTS IN A HARD ROCK AQUIFER.
National Geophysical Research Inst., Hyderabad (India).
M. Thangarajan, and S. Ahmed.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 287-302, 8 fig, 11 ref.

Descriptors: *Aquifers, *Data interpretation, *Groundwater level, *Groundwater resources, *Kriging, *Mathematical analysis, Geohydrology, Groundwater recharge, Mathematical equations, Model studies.

Groundwater levels in the Vaippar basin (a hard rock aquifer in southern India) have been estimated at each node of the aquifer model from a limited number of observations. Universal Kriging was used to estimate the water levels and to calculate the estimation variance. A few more hypothetical locations were selected to reduce the estimation variance near the boundaries. A bivariate interpolation technique using a polynomial of a higher degree was also applied to compare the results. Finally, estimations were made using the theory of Intrinsic Random Function of first order (IRF-k). A single generalized covariance for all pre and post monsoon periods was developed. This study shows two important aspects viz., use of the theory of IRF-k to estimate the water levels at the nodes of an aquifer model and that a single generalized covariance model can be used to estimate the water levels for different time periods. This also helps in estimating water levels in the future without computing a generalized covariance. It was shown that the values of estimation error is more when a model taken for post-monsoon is used. This is due to the fact that the generalized covariance calculated for the water levels in post-monsoon period has a higher nugget effect. The higher value of nugget effect is the result of the large fluctuations in phreatic water levels due to the rainfall recharge. (See also W91-00215) (Lantz-PTT)
W91-00245

RADIAL VERTICAL ELECTRICAL SOUNDINGS: A CASE STUDY IN GROUNDWATER EXPLORATION.
Karnatak Univ., Dharwad (India). Dept. of Studies in Geology.
V. R. Hegde, K. Gowdreddy, and S. B. Chetti.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 303-305, 2 fig.

Descriptors: *Case studies, *Electrical properties, *Geohydrology, *Geophysical surveys, *Groundwater resources, *Sounding, *Vertical electric sounding, Geologic fractures, Groundwater level, India, Resistivity.

Groundwater occurrence in hard rock is mainly confined to the weathered and fractured zone. Crystalline rocks are generally inhomogeneous and anisotropic to the flow of electric current due to the presence of fractures/joints and minor fissures. Radial soundings have been conducted at 11 evenly distributed localities in the northeastern part of the Sasive Halla Basin of Ron Taluk, Dharwad district, India. The sounding curves at differing points within the localities indicate that the top layer of soil has a resistivity varying from 3.6 ohm/m to 88 ohm/m. The depth to the hard and compact basement indicated by the asymptotic nature of vertical electrical sounding curves, varies from very near the surface to 60 m. Borewells drilled at Lakkalakatti and Itgi have yielded 9.72 L/sec (approximately 7000 gal/min. The results of

radial vertical electrical soundings have indicated the presence of fracture patterns and also the intensity and degree of fracturing at different depths. (See also W91-00215) (Lantz-PTT)
W91-00246

DEEP GEOELECTRICAL SOUNDINGS AND SHAPES OF CURVES USED FOR RECOMMENDATIONS OF BORE SITES IN BASALTIC TERRAIN.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
For primary bibliographic entry see Field 7B.
W91-00247

DESCRIPTION OF LINEAMENTS FOUND IN KALAVAD TALUKA OF JAMNAGAR DISTRICT AND DRILLING DRILLED FOR WATER SUPPLY.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
A. J. Merh, S. A. Laghate, and R. K. Patel.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 311-314, 2 fig.

Descriptors: *Geophysical surveys, *Groundwater resources, *India, *Kalavad Taluka, *Remote sensing, *Water supply development, Boreholes, Groundwater movement, Lineaments, Pumping tests, Site selection, Well drilling.

Kalavad Taluka, India, was investigated for water supply under the technology mission for drinking water and scarcity program of 1987-88. Villages were surveyed using remote sensing, geohydrological investigations, and geophysical soundings. The purpose of this groundwater investigation was to locate suitable sites for drilling or digging a bore well in order to establish a dependable water supply. The following observations were made: (1) Most of the successful sites were at the intersection of lineaments with the drainage courses; (2) East-west trending lineaments are more productive;(3) Bores drilled on a lineament crossing a reservoir, dam or talav are more productive; (4) Weathered and fractured dykes are more productive; (5) Pump tests are recommended on boreholes near lineaments which have produced less discharge during drilling; (6) Water bore sites should be established near a village; and (7) If site selection is considered accurate and the bore well is non-productive, it is advisable to conduct a pump test after the monsoon. (See also W91-00215) (Lantz-PTT)
W91-00248

BRISK GROUND WATER INVESTIGATION FOR LOCATING BORE HOLE SITE IS BASALTIC TERRAIN.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
A. J. Merh, and S. A. Laghate.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 315-317.

Descriptors: *Basalts, *Boreholes, *Geophysical surveys, *Groundwater resources, *India, *Resistivity surveys, *Water resources development, Aquifers, Developing countries, Electrical properties, Geohydrology, Groundwater budget, Porosity.

The drought years of 1984-87 created an acute shortage of drinking and irrigation water in Saurashtra, the western portion of Gujarat State, India. The area villages are underlain by deccan trap basalts. Geohydrologically basalt rocks are poor aquifers; they do not possess primary porosity or permeability. Generally, the water levels in open wells in basaltic terrain decline with the approach of summer. In 1987 there was an acute decline in well-water level and groundwater availability in open wells was reduced 80-90% from the normal seasonal yield. Water resources were assessed using remote sensing with the use of imagery and areal photographs. Important features were marked by manual transfer. First-hand information on existing conditions was gathered at each village. The exact yield of water from the point of drilling could not be predicted. Geophysical soundings indicated subsurface variation in resistivities. Neither true resistivity values nor shape of the resistivity curve can assure a solution to the problem. Experience during these surveys showed that five average size villages could be surveyed within eight days of work. A maximum of four geoelectrical soundings can be done in one day. (See also W91-00215) (Lantz-PTT)
W91-00249

FRACTURE PATTERN MODELLING FOR GROUNDWATER TARGETTING IN HARD ROCK TERRAIN: A STUDY AIDED BY REMOTE SENSING TECHNIQUE.
Indian Inst. of Tech., Madras.
For primary bibliographic entry see Field 7C.
W91-00250

ELECTRICAL RESISTIVITY SURVEY FOR GROUND WATER IN VARAHA RIVER BASIN, A.P., INDIA.
Andhra Univ., Waltair (India). Dept. of Geology.
T. V. S. R. Kshira Sagar, and B. Nagamalleswara Rao.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 329-332, 2 fig, 1 tab, 2 ref.

Descriptors: *Data acquisition, *Geophysical surveys, *Groundwater budget, *Groundwater resources, *India, *Resistivity surveys, *Varaha River Basin, Electrical properties, Geohydrology, Groundwater level, Saline water intrusion.

An electrical resistivity survey has revealed the presence of a multilayered system characterized by alternating clay and sand zones along the Varaha River Basin, India. In addition, there are weathered products of country rocks of the Khondalite group. The wide variation observed in the resistivity data reflects the nature of intermixing sand and clay in the zones. The resistivity survey has brought to light the existence of saline zones with calcarious shells south of Lingarajupalem and Karivanipalem areas at shallow depths of 16-20 m below ground level. The low resistivity (2.5 ohm/m) observed in this area is indicative of a marine environment, possibly resulting from the paleo-sea level changes. The yields of tube wells vary from 165-1,665 gallons/day depending on the geohydrological conditions of the area. In the Varaha River basin the depth to static water varies from 5 to 10 m. (See also W91-00215) (Lantz-PTT)
W91-00251

DIGITAL ENHANCEMENT OF SURFACE GEOLOGIC FEATURES IN A PART OF BANAS RIVER CATCHMENT FOR GROUND WATER POTENTIAL CHARACTERIZATION.
Central Ground Water Board, Jaipur (India).
For primary bibliographic entry see Field 7C.
W91-00252

ROLE OF HYDROGEOLOGICAL SET UP IN THE YIELD OF WELLS IN GRANITE TERRAIN: CASE HISTORIES OF NIZAMABAD, WARANGAL AND HINDUPUR AREAS.
Regional Engineering Coll., Warangal (India).
M. P. Ranga Rae, and S. K. Radhakrishnam Raju.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 337-340.

Descriptors: *Geohydrology, *Groundwater yield, *Hindupur, *India, *Nizamabad, *Warangal, *Well yield, Case studies, Drawdown, Drought, Geology, Gneiss, Granites, Groundwater management, Groundwater resources, Remote sensing.

The need for exploration and evaluation of groundwater resources is of considerable importance, especially when considering the severe water shortages in the area of Andhra Pradesh, India, as a result of varying monsoons. Intensive groundwater surveys were conducted in the districts of Nizamabad, Warangal, and Anantapur. These areas were chosen in order to study the occurrence of groundwater in granites and gneisses belonging to unclassified crystallines of the Archean age. A number of sites were located for tube wells, open wells, dug cum borewells and infiltration galleries based on integrated surveys involving geological, geohydrological and geophysical investigations. Remote sensing techniques were utilized to evaluate the structural features of the terrain. All areas that were investigated from 1968-88 were of hard rock terrain. The yields of the tube wells drilled at Nizamabad varied from 400 L/min to 2000 L/min. As many as 20% of the tube wells have registered high yields with reasonable drawdown. All of these tube wells are 15 cm in diameter drilled to a depth of 40-55 meters. In the Warangal area the tube wells produced 8 to 80 L/min. This is considered a low yield. The Hindupur area is notorious for its history of drought. Tube wells delivered 40-240 L/min in this area. (See also W91-00215) (Lantz-PTT)
W91-00253

REMOTE SENSING BASED APPROPRIATE METHODOLOGY FOR THE GROUNDWATER EXPLORATION: A CASE STUDY FROM PRECAMBRIANS OF SOUTH INDIA.
Anna Univ., Madras (India). Inst. of Remote Sensing.
For primary bibliographic entry see Field 7C.
W91-00254

ENVIRONMENTAL ISOTOPE-AIDED STUDY ON RIVER WATER AND GROUNDWATER INTERACTION IN THE REGION OF SEOUL AND TAEGU.
Korea Advanced Energy Research Inst., Daeduk (Republic of Korea).
For primary bibliographic entry see Field 2A.
W91-00257

ESTIMATION OF RECHARGE AND POLLUTANT TRANSFER TO GROUNDWATER BY MODELLING OF UNSATURATED ZONE.
Roorkee Univ. (India). School of Hydrology.
D. Kashyap, K. M. Mohan Rao, and S. Gupta.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 395-403, 2 tab, 15 ref.

Descriptors: *Groundwater recharge, *Mathematical models, *Model studies, *Path of pollutants, *Soil water, *Solute transport, *Unsaturated flow, Data interpretation, Evapotranspiration, Geohydrology, Groundwater movement, Infiltration, Root zone.

The geological formation extending from ground to water table is generally known as the unsaturated zone since only a part of the pore space in this zone is filled with water. The unsaturated zone acts as a conduit for the vertical transfer of water and pollutants to the water table. It also accommodates the root zone of agricultural crops. Thus, the processes of infiltration, evapotranspiration, recharge, pollutant transfer to water table from ground or below, are essentially governed by the unsaturated zone. However, most of the research efforts in groundwater hydrology and hydraulics have been traditionally directed toward the saturated zone. An attempt is made to present basic equations governing the flow and mass transport through the unsaturated zone, and various possible strategies for their solution. A case study is included. Further, the data requirements (such as diffusi-

vity and specific moisture capacity) are highlighted. (See also W90-00215) (Lantz-PTT)
W91-00259

COMPUTER SIMULATION OF AN INJECTED TRACER MOVEMENT.
Central Water and Power Research Station, Poona (India).
N. M. Mahajan.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 423-439, 4 fig, 3 tab, 6 ref.

Descriptors: *Computer programs, *Data interpretation, *Groundwater movement, *Path of pollutants, *Seepage, *Simulation analysis, *Tracers, Aquifers, Flow velocity, Geohydrology, Graphical analysis, Permeability, Porosity.

Problems of seepage hydraulics may be solved using mathematical models written in a finite difference form, and with digital computer programs. These models provide solutions for the two dimensional flow through porous media which gives distribution of groundwater potential at each nodal point. An attempt is made to use the model in a modified form in order to follow the path of an injected tracer, by computing true velocities (porous velocities), from the knowledge of groundwater head distribution, permeabilities, and Darcy velocities. The streamlines are computed by approximating a polygonal succession of straight lines. In each square or rectangular element, velocity vector of streamlines is assumed parallel to the resultant of the porous velocities. The transit time through each segment is computed and totaled to obtain the travel time of the tracer particle from an injection borehole to the observation borehole. Two cases have been studied. In the first case, movement of the tracer is observed in an isotropic aquifer. In the second case tracer movement is observed in a stratified aquifer. The studies indicate that the rate of travel of a tracer is proportional to the permeability of the aquifer. In the case of the stratified aquifer, the inputs of the tracer at the observation points are in proportion to the receptive permeabilities of the strata through which the tracer travels. These studies are useful in predicting contaminant movement. (See also W91-00215) (Lantz-PTT)
W91-00262

INTERACTIVE GROUNDWATER DATABASE SYSTEM.
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W91-00263

BOREHOLE RESISTIVITY LOGGING IN PVC SCREENED WELL.
National Geophysical Research Inst., Hyderabad (India).
S. V. V. Prasada Rao, G. Varadarajan, P. Prabhakara Prasad, K. Subrahmanyam, and T. Seshunarayana.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 457-460, 2 fig, 1 ref.

Descriptors: *Borehole geophysics, *Boreholes, *Data acquisition, *Logging (Recording), *Polyvinyl chloride pipe, *Resistivity surveys, *Screened wells, Porosity, Salinity, Water quality, Wells.

Normal resistivity logs run in a PVC screened well in unconsolidated formations, and exhibit almost the same curve characteristics as that of an open mud-filled hole. The log normal curve is almost identical in both the screened and uncased well. The short normal curve shows a slight increase in resistivity of the screened well when compared to the open well. This method is particularly useful for logging in collapsing formations such as coastal sediments. Periodic logging in PVC screened wells will enable the measurement of changes in porosity and water salinity during the life span of a well. (See also W91-00215) (Lantz-PTT)
W91-00264

TECHNIQUES OF AQUIFER PARAMETER EVALUATION USING POCKET COMPUTERS.
V.O.C. Coll., Tuticorin (India). Dept. of Geology.
A. Balasubramanian, and J. C. V. Sastri.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 461-469, 2 fig, 2 tab, 11 ref, append.

Descriptors: *Aquifers, *Computers, *Data interpretation, *Groundwater movement, *Pumping tests, Computer programs, Mathematical equations, Performance evaluation.

Pocket computer techniques of aquifer parameter evaluation involves both simple and iterative computations. Simple methods enable approximating properties such as transmissivity and storage coefficients, using a least squares approach. Parameter estimation with limited data can also be attempted through iterative techniques. Results obtained with a pocket computer: (1) require less computing time; (2) have simple computational steps; and (3) use less memory constants. Programmable pocket computers cost twenty times less than personal computers, but have the limitations of: (1) using BASIC language; (2) having less memory cells; and (3) have difficulty displaying results. (See also W90-00215) (Lantz-PTT)
W91-00265

ACQUISITION OF HYDROGEOLOGIC DATA FOR THE MAPPING OF SHALLOW UNCONFINED DECCAN BASALTIC AQUIFERS FROM MAHARASHTRA, INDIA.
Poona Univ. (India). Dept. of Geology.
H. Kulkarni, and S. B. Deolankar.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 471-482, 4 fig, 7 ref.

Descriptors: *Aquifers, *Geohydrology, *Hydrologic data collections, *Hydrologic maps, *India, *Maharashtra, Geologic fractures, Groundwater resources, Lithology, Maps, Wells.

The low-permeability Deccan basalts of Maharashtra, India form shallow unconfined aquifers tapped by large-diameter dugwells. The heterogeneity of these aquifers necessitates their detailed geohydrological mapping (on the scale of 1:5000). The basic geohydrological map projects information relevant to the geologic framework of the area, such as: the lithological contacts, the delineation of fracture zones, dykes and the location of dugwells which form the fundamental and in-depth data acquisition unit. The data acquired through the unit, such as subsurface lithological sections, seasonal water levels, and distribution of the areas through which water enters each well, can be used to prepare groundwater maps. Geohydrological maps and the groundwater maps can be effectively used as a base for detailed geohydrological investigations of an area. (See also W90-00215) (Author's abstract)
W91-00266

AQUIFERS OF THE WESTERN MOUNTAIN AREA.
Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. 229p.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater, *Regional Aquifer-Systems Analysis, Geochemistry, Geology, Groundwater development, Groundwater movement, Groundwater potential, Groundwater resources, Hydraulics, Hydrology, Regional analysis, Western Mountain Region.

Understanding an entire aquifer system is essential for water managers to adequately evaluate the impacts of large groundwater developments. Study of groundwater systems must be done on a regional basis that cuts across the political boundaries. The U.S. Geological Survey instituted the Regional Aquifer-System Analysis (RASA) Program in 1978 to provide the information needed by scientists and managers for proper groundwater development in the U.S. The objectives of each RASA study are to define the regional hydrology and to establish the framework (geologic, hydraulic, and geochemical) for detailed local investigations. This monograph contains papers presented at the special RASA session on Aquifers of the Western Mountain Area held 1-6 November 1987 at Salt Lake City, Utah during the 23rd Annual Conference and Symposium of the American Water Resources Association. Five RASA projects are represented: Northern Great Plains Regional Aquifer (1 paper), Snake River Plain (1 paper), Great Basin (1 paper), Upper Colorado River Basin (8 papers), and San Juan Basin (2 papers). In addition, a list of publications of the RASA studies discussed in the monograph is presented. (See W91-00305 thru W91-00317) (MacKeen-PTT)
W91-00304

REGIONAL BEDROCK AQUIFERS OF THE NORTHERN GREAT PLAINS, NORTH-CENTRAL UNITED STATES.
Geological Survey, Lakewood, CO. Water Resources Div.
J. S. Downey.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 5-13, 3 fig, 23 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater movement, *Regional Aquifer-Systems Analysis, Bedrock aquifers, Great Plains, Hydrodynamics, Petroleum.

At least five major aquifers underlie the northern Great Plains of the United States. These aquifers form a hydrologic system that extends for more than 600 miles from the recharge areas in the Rocky Mountains to discharge areas in eastern North Dakota and the Canadian Provinces of Manitoba and Saskatchewan. The regional groundwater flow system in the aquifers has affected the water composition within the Williston basin. Hydrodynamic forces involved with the flow system may contribute to the accumulation of petroleum within the basin. (See also W91-00304) (Author's abstract)
W91-00305

SNAKE RIVER PLAIN REGIONAL AQUIFER SYSTEM STUDY.
Geological Survey, Boise, ID. Water Resources Div.
G. F. Lindholm.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 15-36, 15 fig, 17 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater, *Groundwater movement, *Regional Aquifer-Systems Analysis, Agricultural water, Basalts, Flow models, Groundwater discharge, Groundwater management, Groundwater recharge, Hy-

draulic conductivity, Hydrologic budget, Irrigation, Model studies, Simulation analysis, Snake River Plain, Springs, Transmissivity, Water use.

Two-thirds of the 15,600 sq mile Snake River Plain and most of the 10,800 square mile eastern part of the plain are underlain by Quaternary basalt of the Snake River Group. Electrical resistivity soundings indicate that, in places, the basalt may be as much as 5,000 ft thick. Water moves horizontally through vesicular, extensively broken flow tops and vertically through fractures. Hydraulic conductivity decreases with depth and most water moves through the upper 200 to 500 ft of the aquifer, where an estimated 200 million to 300 million acre-ft are stored. Model analyses indicate that transmissivity of the upper 200 ft of the basalt aquifer generally exceeds 100,000 sq ft/day and, in places, 1 million sq ft/day. Simulation indicates that transmissivity of the entire aquifer may be as much as 4 million sq ft/day. Water in the aquifer generally flows southwestward. Most discharge is spring flow to the entrenched Snake River between Milner and King Hill. Piezometers verify vertical flow components in recharge and discharge areas. Use of surface water for irrigation since the 1880's increased groundwater recharge, storage, and discharge until the 1950's when trends were reversed. In 1880, about two-thirds of the 3.2 million acre-ft of recharge in the eastern part of the plain was from drainage basins tributary to the plain; all discharge was to the Snake River. In 1980, nearly two-thirds of the 6.7 million acre-feet of recharge was from surface water irrigation and 20% of the discharge was pumpage for irrigation. About 3.1 million acres, or one-third of the plain, were irrigated in 1980; 2 million acres were supplied by surface water, 1 million by groundwater pumped from 5,300 wells, and 0.1 million by combined surface water and groundwater. (See also W91-00304) (Author's abstract)
W91-00306

GROUND-WATER FLOW SYSTEMS OF WESTERN UTAH.
Geological Survey, Salt Lake City, UT. Water Resources Div.
J. S. Gates, and M. S. Bedinger.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 37-55, 9 fig, 19 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater, *Groundwater movement, *Regional Aquifer-Systems Analysis, *Well water, Dissolved solids, Drinking water, Flow system, Great Salt Lake, Groundwater discharge, Groundwater recharge, Selective withdrawal, Sevier Lake, Utah, Water quality.

Groundwater is an important source of supply in western Utah. About 85% of the water withdrawn from wells in Utah is from this area. Most water has been developed from aquifers in basin-fill deposits, although substantial quantities of water also occur locally in carbonate rocks. An estimated 70 million acre-ft of water is stored in the uppermost 100 ft of saturated basin fill. Three regional groundwater flow systems occur in western Utah: Great Salt Lake, Great Salt Lake Desert, and Sevier Lake systems. These flow systems are recharged by water from the mountains and plateaus at the eastern edge of the Basin and Range province and from mountains within the province; movement and discharge of water are along paths to three lowest discharge, or sink areas: Great Salt Lake, Great Salt Lake Desert, and Sevier Desert/Sevier Lake area. Groundwater in the major areas of withdrawal is generally of suitable quality for public supply, commonly containing less than 1,000 mg/L of dissolved solids. Areas with the best quality groundwater, containing less than 500 mg/L of dissolved solids, are in the mid-elevation to upper-elevation parts of local flow systems. Groundwater in the lower parts of the local flow systems contains concentrations of dissolved solids generally exceeding 1,000 mg/L, at least partly because natural discharge has concentrated salts in the water. (See also W91-00304) (Author's abstract)
W91-00307

UPPER COLORADO RIVER BASIN REGIONAL AQUIFER-SYSTEMS ANALYSIS: MESOZOIC ROCKS IN COLORADO, UTAH, AND WYOMING, ARIZONA, AND NEW MEXICO.
Geological Survey, Salt Lake City, UT. Water Resources Div.
G. W. Freethey.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 57-70, 7 fig, 1 tab, 6 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater, *Groundwater movement, *Groundwater resources, *Regional Aquifer-Systems Analysis, Arizona, Calcium bicarbonate, Colorado, Flow system, Groundwater discharge, Groundwater management, Groundwater recharge, Mesozoic rocks, New Mexico, Saline water, Transmissivity, Upper Colorado River Basin, Utah, Water supply, Wyoming.

The Upper Colorado RIver Basin Regional Aquifer-Systems Analysis (RASA) began in 1981 and was the 14th such study conducted by the U.S. Geological Survey. Mesozoic rocks underlie about 85,000 sq mi in the Upper Colorado River Basin, excluding the Upper San Juan River Basin in New Mexico. In places, within the deep structural basins of southwestern Wyoming, northwestern Colorado, and northeastern Utah, the thickness of these sedimentary rocks exceeds 15,000 ft. To facilitate more detailed analysis, the Mesozoic rocks were divided into five aquifers and five confining units. The five aquifers contain about 10 billion acre-ft of water, but much of it is deep below the land surface and saline. Only about 5% of the water is considered recoverable and suitable for most uses. Recharge to and discharge from the regional groundwater system in Mesozoic rocks is estimated to be about 1 million acre-ft/year. The aquifers in the southern one-half of the basin contain most of the usable groundwater in sandstone. The sandstone may be fractured locally. Transmissivity exceeds 2,000 sq ft/day in small parts of the areas where saturated thickness is several thousand feet and locally where aquifers are extremely fractured. The fresh water generally is a calcium bicarbonate type and the briny water is a sodium chloride type. Region-wide development of the groundwater resources in rocks of Mesozoic age has been negligible, but development has affected some aquifers locally. (See also W91-00304) (Author's abstract)
W91-00308

SOURCES OF HYDROLOGIC DATA ON MESOZOIC FORMATIONS IN THE UPPER COLORADO RIVER BASIN AND COMPARISON OF DATA ANALYSIS METHODS.
Geological Survey, Albany, NY. Water Resources Div.
J. F. Weigel.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 71-80, 4 fig, 11 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Data acquisition, *Data interpretation, *Geohydrology, *Groundwater resources, *Hydrologic data, *Regional Aquifer-Systems Analysis, Analytical methods, Data collections, Groundwater management, Hydraulic conductivity, Mesozoic rocks, Upper Colorado River Basin, Water level, Water supply, Wells.

Hydrologic data were collected and compiled from publications and from public and private sources for an aquifer systems analysis of the Upper Colorado River Basin. Hydrologic and lithologic data representing 104 Mesozoic formations were obtained; these provide coverage throughout the study area but not for the entire extent of any one formation. The data (representing 1,208 sites) were obtained through five methods of collection and analysis, but the resulting values for hydrologic properties are not directly comparable because the methods of data collection present differing volumes of aquifer. The methods include aquifer tests (73), which represent the largest aquifer volume; specific-capacity tests (380) and drill-stem tests (630), which represent a somewhat smaller aquifer volume; slug-injection tests (8), which represent a still smaller aquifer volume; and analyses of cores (from 262 sites), which represent the smallest aquifer volume. Two or more methods were used at some sites. Hydraulic conductivity (K), in millidarcies per centipoise, can be closely estimated from a sample's permeability to air (k) in millidarcies. Water level data from 1,125 water wells and 1,871 petroleum test holes were obtained; those measured in water wells are more accurate than those calculated from formation fluid pressures in petroleum test holes. (See also W91-00304) (Author's abstract)
W91-00309

LITHOLOGIC AND HYDROLOGIC PROPERTIES OF MESOZOIC ROCKS IN THE UPPER COLORADO RIVER BASIN.
Geological Survey, Salt Lake City, UT. Water Resources Div.
G. W. Freethey.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 81-99, 12 fig, 1 tab, 13 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Geohydrology, *Groundwater resources, *Hydrologic properties, *Lithology, *Regional Aquifer-Systems Analysis, Geohydrologic units, Groundwater management, Groundwater storage, Hydraulic conductivity, Mesozoic rocks, Porosity, Sandstones, Stratigraphy, Upper Colorado River Basin.

Lithologic and hydrologic properties of 5 aquifers and 5 confining units of Mesozoic rocks were determined for the Upper Colorado River Basin Regional Aquifer Systems Analysis (RASA) by laboratory tests, drill-stem tests, specific capacity tests, and miscellaneous field tests using pumping and flowing wells. Most Mesozoic sandstones are very fine to fine grained and contain differing amounts of silica or carbonate cement. For Mesozoic sandstones, the relationship between grain size statistical parameters, such as mean size, sorting, skewness and kurtosis, and hydraulic conductivity, is indefinite probably because of the differing degree of cementation. Effective porosity ranges from less than 10 to 30% in aquifers, and generally decreases with depth. Geohydrologic units designated as aquifers and those designated as confining units are distinguishable on the basis of relative differences in permeability to air. Aquifers generally are from 3 to 70 times more permeable than overlying or underlying confining units. Hydraulic conductivity is largest in the Morrison, Navajo-Nugget, and Entrada-Preuss aquifers and smallest in the Dakota and Mesaverde aquifers. Hydraulic conductivity decreases with increasing depth and decreasing dissolved solids concentration. Despite differences in effective porosity, permeability, and hydraulic conductivity among aquifers, groundwater storage capacity probably is largest in the thickest units: the Mesaverde and Navajo-Nugget aquifers. Hydraulic conductivity values derived from various methods differ somewhat, but only the values from drill-stem tests were significantly different. Values derived from drill-stem tests are smaller because tested intervals are deeper and the rocks probably are more cemented than in inter-

vals analyzed by other methods. (See also W91-00304) (Author's abstract)
W91-00310

HYDROLOGY OF THE NAVAJO SANDSTONE IN SOUTHEASTERN AND SOUTHERN UTAH.
Geological Survey, Albuquerque, NM. Water Resources Div.
P. J. Blanchard.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 101-119, 12 fig, 1 tab, 17 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater, *Groundwater resources, *Hydrologic properties, *Navajo Sandstone, *Regional Aquifer-Systems Analysis, Groundwater discharge, Groundwater management, Groundwater recharge, Hydraulic conductivity, Lithology, Porosity, Sandstones, Transmissivity, Utah.

The hydrology of the Navajo Sandstone has been investigated in about 27,000 square miles of southeastern and southern Utah. The Navajo Sandstone is mostly a fine-grained, well sorted, crossbedded, eolian sandstone of Triassic and Jurassic age. The lithology of the Navajo Sandstone is nearly uniform throughout both its areal and vertical extent. The Navajo Sandstone thickens westward from being locally absent near the Colorado State line to about 2,000 ft in southwestern Utah. No readily apparent geographical trend exists in median grain size, sorting coefficient, or porosity. A general northeast to southwest increase in horizontal hydraulic conductivity occurs, ranging from less than 1 ft/day in the northeast to about 2 or more ft/day in the southwest. A general northeast to southwest increase in transmissivity also occurs, ranging from about 2,000 feet squared per day in the northeast to about 5,000 sq ft/day in the southwest. This increase is due to the increase in thickness and hydraulic conductivity of the Navajo Sandstone in the same direction. Recharge to the Navajo Sandstone occurs mostly from winter precipitation. The quantity of recharge is larger where the formation is extensively fractured or where the formation is overlain by thick, sandy, unconsolidated deposits. Natural discharge from the Navajo typically occurs as seeps and small springs that have rates of discharge of less than 5 gal/min, but that have been reported to be as large as 390 gal/min. Rates of discharge from wells range from less than 1 to more than 3,000 gal/min, and generally increase from northeast to southwest. The larger rates of discharge typically occur near structural features where the formation is extensively fractured. (See also W91-00304) (Author's abstract)
W91-00311

GEOCHEMISTRY OF WATER ASSOCIATED WITH THE NAVAJO SANDSTONE AQUIFER, SAN RAFAEL SWELL AREA, UTAH.
Geological Survey, Denver, CO. Water Resources Div.
B. A. Kimball.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 121-133, 7 fig, 2 tab, 22 ref.

Descriptors: *Aquifer characteristics, *Aquifers, *Geochemistry, *Geohydrology, *Groundwater dating, *Navajo Aquifer, *Navajo Sandstone, *Regional Aquifer-Systems Analysis, *Stable isotopes, *Water chemistry, Carmel formation, Dissolved solids, Groundwater recharge, Minerals, Saline water, Utah.

Water samples collected from the Navajo aquifer in south-central Utah indicate that there are areas that have dissolved solids concentrations larger than normal for the region. These larger concentrations result solely from chemical reactions between aquifer minerals and the groundwater. Stable isotope ratios of water samples collected from the aquifer indicate that, in some areas, water in the Navajo Aquifer may have acquired solutes from dissolving minerals in the Carmel Formation. Those groundwater samples with the greatest salinity have stable isotope ratios characteristic of water in the Carmel Formation. After accounting for the sources of bicarbonate in these waters, the ages determined by C-14 activity were corrected. The resulting ages ranged from 8,100 to 15,600 years in samples distant from recharge areas. This range corresponds to the high stand of late Pleistocene lakes, and may indicate that recharge occurred during wetter climatic conditions. (See also W91-00304) (Author's abstract)
W91-00312

HYDROSTRATIGRAPHIC CHARACTERIZATION OF PALEOZOIC FORMATIONS IN THE UPPER COLORADO RIVER BASIN, ARIZONA, COLORADO, NEW MEXICO, UTAH, AND WYOMING.
Geological Survey, Denver, CO. Water Resources Div.
A. L. Geldon.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 135-159, 12 fig, 3 tab, 41 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Aquifers, *Geohydrology, *Groundwater movement, *Hydrologic properties, *Regional Aquifer-Systems Analysis, Arizona, Colorado, Flow system, Groundwater recharge, Hydrostratigraphy, New Mexico, Paleozoic rocks, Stratigraphy, Upper Colorado River Basin, Utah, Wyoming.

The stratigraphy, hydrologic properties, and hydrodynamics of Paleozoic sedimentary rocks in the Upper Colorado River Basin were investigated as part of the Regional Aquifer Systems Analysis program of the U.S. Geological Survey. The study area includes parts of the Middle Rocky Mountains, Southern Rocky Mountains, Wyoming Basin, and Colorado Plateaus physiographic provinces. Paleozoic formations from all systems except the Silurian are present. Their combined thickness ranges from 0 to 18,000 ft. Depths of burial range from 0 to 27,000 ft. The Paleozoic rocks comprise 11 hydrostratigraphic units: two regional aquifers, four local aquifers, and five confining layers. The largest values of porosity, permeability, hydraulic conductivity, transmissivity, and artesian well and spring yield are consistently exhibited by the two regional aquifers: the Devonian and Mississippian carbonate rocks hydrostratigraphic unit and the Pennsylvanian and Permian sandstone hydrostratigraphic unit. The smallest values of these properties are consistently exhibited by the confining layers. Transmissivity within individual hydrostratigraphic units ranges from 0.001 to 47,000 sq ft/day; yields range from less than 1 to 10,000 gal/min. Recharged mostly by precipitation and leakage from streams, groundwater moves from peripheral and internal divides to structural basins and stream valleys, where springs, seepage to stream alluvium, production from wells, evapotranspiration, upward movement to Mesozoic and Tertiary rocks, and outflow to Pennsylvanian shale and carbonate rocks hydrostratigraphic unit and the Mississippian and Pennsylvanian carbonate rocks and evaporites hydrostratigraphic unit separate the Paleozoic rocks into two flow systems. Vertical exchange of water between these flow systems occurs locally. (See also W91-00304) (Author's abstract)
W91-00313

GEOPHYSICALLY DETERMINED POROSITY OF PALEOZOIC ROCKS IN THE UPPER COLORADO RIVER BASIN.
Geological Survey, Lakewood, CO. Water Resources Div.
G. A. Wetherbee, and W. P. Van Liew.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 161-169, 6 fig, 2 tab, 8 ref.

Descriptors: *Aquifer characteristics, *Borehole geophysics, *Geohydrology, *Geophysical surveys, *Groundwater resources, *Paleozoic rocks, *Porosity, *Regional Aquifer-Systems Analysis, Aquifers, Data interpretation, Dolomite, Geologic formations, Limestone, Sandstones, Upper Colorado River Basin.

As part of the Regional Aquifer System Analysis of the Upper Colorado River Basin, porosity of mostly clean Paleozoic sandstone, limestone, and dolomite formations was estimated from borehole geophysical logs of oil and gas exploration wells. Assumptions concerning physical properties of formations, such as lithology, formation and interstitial fluid densities, and sonic pulse transmit times, enabled porosity to be calculated from sonic, bulk-density, and neutron-porosity logs. Geophysical porosity values determined from these logs were compared with porosity determined in the laboratory from borehole core samples. Average porosity values were 1.0-16.2% for Permian and Pennsylvanian sandstone, 0.4-10.5% for Mississippian and Devonian carbonate rocks, 5.0% for Ordovician rocks from one well in Bighorn Dolomite, and 11.7% for Cambrian rocks from one well in Sawatch Quartzite. (See also W91-00304) (MacKeen-PTT)
W91-00314

POROSITY AND PERMEABILITY OF THE PALEOZOIC ROCKS IN THE UPPER COLORADO RIVER BASIN, ARIZONA, COLORADO, NEW MEXICO, UTAH, AND WYOMING.
Geological Survey, Denver, CO. Water Resources Div.
A. L. Geldon.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 171-190, 13 fig, 2 tab, 23 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Geohydrology, *Paleozoic rocks, *Permeability, *Porosity, *Regional Aquifer-Systems Analysis, Anhydrite, Aquifers, Dolomite, Halite, Hydrologic properties, Limestone, Lithology, Sandstones, Sedimentary rocks, Shales, Stratigraphy, Upper Colorado River Basin.

The porosity and permeability of Paleozoic sedimentary rocks in the Upper Colorado River Basin were studied as part of the Regional Aquifer Systems Analysis program of the U.S. Geological Survey. Among common rock types, sandstone was found to have the highest porosity and intergranular permeability, followed by dolomite, limestone, shale, anhydrite, and halite. The porosity and intergranular permeability of sandstone increase with increasing grain size and decreasing amounts of interstitial minerals and cement. The porosity and intergranular permeability of carbonate rocks are smallest in fine-grained, crystalline, laminar, and brecciated varieties and largest in grainy, vuggy, and nodular varieties. Intergranular permeability in sandstone appears to be related to porosity in most hydrostratigraphic units, whereas carbonate rocks in many hydrostratigraphic units display little or no correlation between the two hydrologic properties. There is virtually no relation between either porosity or intergranular permeability and depth in Paleozoic carbonate rocks and only a vague relation between these hydrologic properties and depth in Paleozoic sandstone. The permeability of all hydrostratigraphic units increases from structural basins to uplifted areas as

the rocks comprising them become more fractured and less cemented. On the average, sandstone is more porous but less permeable in aquifers than in confining layers; dolomite is more porous but less permeable; limestone is less porous and permeable; and shale is more porous but equally permeable. In-situ permeability generally is larger than intergranular permeability because of fractures and solution channels. Median ratios of orthogonally measured intergranular permeability range from 1:1 to 3:1. (See also W91-00304) (Author's abstract)
W91-00315

USING A GEOGRAPHIC INFORMATION SYSTEM TO DEVELOP A GROUND-WATER FLOW MODEL.
Geological Survey, Albuquerque, NM. Water Resources Div.
J. M. Kernodle, and R. D. Philip.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 191-202, 5 fig, 7 ref.

Descriptors: *Computer models, *Flow models, *Geographic information systems, *Geohydrology, *Groundwater movement, *Model studies, *Regional Aquifer-Systems Analysis, Aquifers, Arizona, Colorado, Flow system, Groundwater recharge, Morrison Formation, New Mexico, San Juan Basin, Traveltime, Utah.

A geographic information system was used to manipulate spatial data and formulate those data as input for a preliminary, three-dimensional, finite-difference, groundwater flow model of the flow system in the Morrison Formation and the Dakota and Gallup Sandstones in the San Juan structural basin of New Mexico, Colorado, Arizona, and Utah. The primary purpose of the model was to aid in the selection of sampling sites for the age dating of groundwater by developing preliminary numerical estimates of predevelopment hydraulic heads, flow paths, and travel times of water from recharge areas to potential sample sites in the Morrison Formation. During the compilation of model input, a set of semi-automated procedures using a geographic information system to process spatial data was tested and refined. When the procedures were refined, the model grid was redimensioned and the redefined model was operational in 2 days. These procedures provide the potential to: (1) easily test large-scale, finite-difference models for their sensitivity to grid dimension and orientation; and (2) allow the hydrologist to concentrate on accurate spatial analysis of hydrologic properties rather than on subjective cell by cell parameter assignments, which are tedious and difficult to change. The techniques that were refined during the preparation of the preliminary model will be used to prepare a much more encompassing and detailed groundwater flow model that will be used to simulate a minimum of 14 aquifers and confining units. (See also W91-00304) (Author's abstract)
W91-00316

METHODS AND PRELIMINARY RESULTS OF GEOCHEMICAL SAMPLING, SAN JUAN BASIN, NEW MEXICO, COLORADO, ARIZONA, AND UTAH.
Geological Survey, Albuquerque, NM. Water Resources Div.
W. L. Dam.
IN: Aquifers of the Western Mountain Area. Papers presented at 23rd Annual American Water Resources Association Conference and Symposium, November 1-6, 1987, Salt Lake City, Utah. Regional Aquifer Systems of the United States, AWRA Monograph Series No. 14. American Water Resources Association, Bethesda, Maryland. 1988. p 203-217, 7 fig, 25 ref.

Descriptors: *Aquifer characteristics, *Aquifers, *Chemical analysis, *Data acquisition, *Geochemistry, *Geohydrology, *Groundwater movement, *Regional Aquifer-Systems Analysis, *Sampling, *Water analysis, Flowing wells, Groundwater dating, Meteoric water, Morrison Formation, New Mexico, Radioisotopes, San Juan Basin, Stable isotopes, Water sampling.

Geochemical data were collected by the U.S. Geological Survey from aquifers in Jurassic and Cretaceous rocks in the New Mexico part of the San Juan Basin to evaluate regional trends in groundwater flow and geochemistry. Standard methods including on-site precipitation of C-14 were used to collect samples for dissolving constituents, stable isotopes, and radioactive isotopes. Sixteen flowing wells completed primarily in the Jurassic Morrison Formation in the northwest part of the basin were sampled in 1986. The following general trends in concentrations were present down-gradient from recharge areas: major cations, chloride, sulfate, bromide, fluoride, iodide, iron, and strontium increased; pH, bicarbonate, and carbonate decreased; organic carbon, silica, and most trace elements did not change significantly. Stable isotopes of oxygen and hydrogen in 11 samples near the basin margin indicate a meteoric water origin; 3 samples from the central part of the basin were relatively depleted in deuterium. The median values for delta S-34 (sulfate) and delta C-13 were 10.1 and -10.4 permil. Only in one of four samples analyzed did C-14 exceed the detection limit; it had an activity of 3.1 +/-0.2 percent modern carbon. On the basis of 1986 results, samples were collected in 1987 for delta S-34 in on-site precipitated sulfide and for Cl-36. (See also W91-00304) (Author's abstract)
W91-00317

HYDROGEOLOGY OF THE DINARIC KARST.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
B. F. Mijatovic.
International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. 254p.

Descriptors: *Aquifer systems, *Dinaric Karst, *Geohydrology, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Yugoslavia, Geologic formations, Geology, Groundwater development, Groundwater movement, Regional analysis, Water resources, Water table.

This monograph on the hydrogeology of the Dinaric Karst in Yugoslavia was prepared on the occasion of the Field Trip to the Dinaric Karst of 15-28 May 1983, which was organized by the International Association of Hydrogeologists (Yugoslav National Committee). The original concept of the study of karst as an exceptional natural phenomenon is being supplanted more and more by approaches oriented towards rational and complete utilization of water resources, paying due consideration to technical, economic and social aspects. The volume includes 13 papers prepared by Yugoslav authors dealing with karst hydrology and methods of investigation. It is intended as a broad insight into the hydrogeologic problems of the Dinaric Karst, and thus a contribution to a wider and more comprehensive exchange on problems of hydrogeological systems in karst areas worldwide. (See W91-00319 thru W91-00330) (MacKeen-PTT)
W91-00318

GEOLOGY OF KARST TERRAINS AND THEORY IN THE WORKS OF JOVAN CVIJIC.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 8E.
W91-00319

HYDROGEOLOGIC REGIONAL CLASSIFICATION OF KARST IN YUGOSLAVIA.
Institute of Geology, Zagreb (Yugoslavia).
A. Sarin.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 42-54, 1 fig, 18 ref.

Descriptors: *Aquifer systems, *Aquifers, *Geohydrology, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Yugoslavia, Geohydrologic boundaries, Groundwater, Regional analysis.

A hydrogeologic regional classification scheme of karst in Yugoslavia is presented, beginning with a review of previous classifications introduced from 1909 to 1977. The present scheme was shaped by actual hydrogeologic conditions as well as their practical consequences, and by integrity in geographic distribution. The four regional classes of karst in Yugoslavia were designated: Adriatic Karst Belt, High Karst Belt, Fluviokarst Belt, and Isolated Karst. The first three belts represent subregions of the Karst Hydrogeologic Region, while the Isolated Karst are isolated karst regions within two remaining hydrogeologic regions of Yugoslavia, the Inner Region in the central and eastern parts, and the Pannonian Region in the north-central and north-eastern parts of the country. The Karst Hydrogeologic Region comprises an integral, long and wide belt in the southwest part of Yugoslavia. Its southwest border is the southwestern coastline of the extreme Adriatic Islands and its northeastern border is the boundary of the Inner Hydrogeologic Region. All of the islands are included. The region is about 650 km long and 60-150 km wide for the continental region, or 159-200 km wide when the islands are included. The area amounts to about 69,650 sq km. The Isolated Karst is widely dispersed over the remaining two hydrogeologic regions in a total area of approximately 18,300 sq km. All the four subregions give a total area of karst terrains near 88,000 sq km, which is 34% of the Yugoslavian territory. (See also W91-00318) (MacKeen-PTT)
W91-00320

HYDROGEOLOGIC FEATURES OF THE DINARIC KARST.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
M. Komatina.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 55-73, 5 fig, 9 ref.

Descriptors: *Aquifer systems, *Aquifers, *Dinaric Karst, *Geohydrology, *Groundwater movement, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Yugoslavia, Adriatic Sea, Black Sea, Catchment areas, Flow velocity, Geohydrologic boundaries, Geohydrologic units, Groundwater, Groundwater discharge, Groundwater recharge, Limestone.

A review of the hydrogeologic features of the Dinaric Karst Region in Yugoslavia is presented. The region is composed mainly of limestone with a porosity generally ranging from 0.5 to 1.5%. The Dinaric Region is characterized by extremely high precipitation, typically 2000 mm/yr for the majority of mountainous areas. The distribution and movement of groundwater in the region has been extensively studied. In particular, the position of the Adriatic/Black Sea watershed has been described. Water from more than two-thirds of the Dinaric Karst Region flows to the Adriatic Sea. Direction of flow was studied using sodium fluorescein and other tracers, revealing the following general conditions: (1) concentration of flow directions from a series of ponors towards a single water body, and (2) radial dispersion of a beam of directions from a single ponor towards a larger number of underground water bodies. The average water flow velocity for the region was 3.6 cm/s. Considering only stronger water discharge (greater than 0.5 cu.m./s), there are 105 drainage points, 60% of which are waters of the Adriatic catchment area and the rest are springs from the Black Sea catchment area. A review of the more important hydrogeologic units of the Adriatic and the Black Sea catchment areas is also presented. (See also W91-00318) (MacKeen-PTT)
W91-00321

SPELEOLOGICAL PHENOMENA OF DINARIC KARST.
Institute for Karst Research, Postojna (Yugoslav-

ia).
P. Habic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 74-86, 1 fig, 35 ref.

Descriptors: *Aquifer systems, *Aquifers, *Caves, *Dinaric Karst, *Geohydrology, *Geomorphology, *Karst, *Regional Aquifer-Systems Analysis, *Yugoslavia, Cavern flow, Groundwater, Groundwater movement, History, Limestone.

A review of the speleological properties of the Dinaric Karst showed that the main factors influencing these properties are complicated geological setting, differentiated relief, high humidity, and varied geologic history. The history of speleological investigations in the region can be divided into two important periods: the period from the mid-16th century to the end of the 19th century, characterized by individual expeditions, and the period since 1883, when the first speleological society was founded. Dinaric karst can be divided by general orographic morphological properties into three longitudinal zones: Low Littoral Karst, High Dinaric Karst, and Inner Dinaric Karst. Speleological properties differentiate after particular hydrogeological units, with direction of underground runoff playing an important role. Karst caverns in pure limestone of deep karst can be divided by form and origin into two basic types: (1) mostly corrosional vertical potholes, and (2) erosional caves. Simple, deep potholes, composed potholes, snow potholes, horizontal karst caverns, dry karst caverns, and active water caves are all speleological features found in the Dinaric Karst. (See also W91-00318) (MacKeen-PTT)
W91-00322

KARST POLJES IN DINARIDES.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
B. F. Mijatovic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 87-109, 5 fig, 3 tab, 15 ref.

Descriptors: *Aquifer systems, *Dinaric Karst, *Geohydrology, *Geologic formations, *Geology, *Geomorphology, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Yugoslavia, Carbonate rocks, Groundwater, Groundwater movement, Poljes, River sediments, Sediments.

The genesis, evolution and geohydrological functioning of karst poljes in the Dinarides is reviewed. Karst poljes, which are typically closed depressions, are the largest form of carbonate rock megarelief. The two most important factors in the formation of karst poljes in the Dianarides mountainous territories were geological and paleoclimatic. Common features of karst poljes in the Dinarides include elongated shape, direction from northwest to southeast, variable size (1-433 cu km), step-like position, tectonic predisposition, and flat bottom covered by stream sediment deposits. Surface water of karst poljes drain through underground routes, and poljes are periodically flooded. Present karst poljes forms are not a result of river erosion, but originated from accumulation of loose sediments deposited by water currents in the lowest parts of former karst relief. The hydrodynamic regime in karst poljes depends on three basic factors: (1) lithologic composition of the rocks forming the karst polje base; (2) hypsometric position of the polje in regard to the lower groundwater draining steps; and (3) presence or absence of hydrogeologic barriers in the polje. (See also W91-00318) (MacKeen-PTT)
W91-00323

REVIEW OF SOME SIGNIFICANT PONORS IN SINJSKO AND DUVANJSKO POLJES.
Institute of Geology, Zagreb (Yugoslavia).
S. Bozicevic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 110-114, 3 fig.

Descriptors: *Aquifer systems, *Geohydrology, *Geologic formations, *Geology, *Geomorphology, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Sinkholes, *Yugoslavia, Canals, Dinaric Karst, Groundwater level, Groundwater movement, Limestone, Underground streams.

The geological features of selected ponors in Sinjsko and Duvanjsko Poljes are reviewed. The Sinjski Ponor Zone is located on the western margin of former Busko blato and consists of a natural channel and a number of additionally drilled sections. The complex morphology of the Sinjski Ponor and detection of water flow at the lowest drilled holes indicate an abrupt lowering of the groundwater level at the margin of the polje. The Stara Mlinica Ponor is the best known ponor of the Busko blato. It is closely connected with the fractured limestone zone and serves to discharge high waters. The Kovaci Ponor is in the Duvanjsko Polje. The entrance to the ponor has two holes, over 20 m wide and high. This structure contains horizontal canals which at a distance from the entrance continue in the form of syphon basins. The total length of all underground canals investigated in this ponor to date is 180 m. (See also W91-00318) (MacKeen-PTT)
W91-00324

PROBLEMS OF SEA WATER INTRUSION INTO AQUIFERS OF THE COASTAL DINARIC KARST.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
B. F. Mijatovic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 115-142, 15 fig, 1 tab, 7 ref.

Descriptors: *Aquifer systems, *Coastal aquifers, *Geohydrology, *Groundwater management, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Saline water barriers, *Saline water intrusion, *Water quality, Aquifers, Boreholes, Dinaric Karst, Groundwater barriers, Groundwater level, Pumping, Water resources, Water supply, Yugoslavia.

The problems of sea water intrusion into aquifers of the coastal Dinaric karst are discussed. Littoral karst aquifers subject to sea water intrusion can be divided into two groups: aquifers opened to the sea and aquifers with incomplete barriers to the sea. In aquifers opened to the sea, exploitation of the fresh water zone always causes the intrusion of brackish water into the fresh water zone. In general, the intensity of this disturbance is less for greater distance between the captage and the sea. Captages consisting of horizontal drainage galleries provided the maximum water yields and the fewest salt water effects by regulation of pumping rate or by construction of an artificial barrier perpendicular to the direction of water circulation. In littoral karst aquifers with incomplete barriers to the sea, sea water intrusion is localized to that part of the aquifer between sea level and the contact surface of the aquifer with the impermeable barrier. To avoid penetration of salt water into captage, it is necessary to stop pumping at any sudden disturbance of water level, or to increase the piezometric level of fresh water over the minimum critical water level. To protect against saline water intrusion, it is necessary to install a network of observation boreholes for measuring the brackish zone, both in its vertical and horizontal profiles. Examples of fresh water captation works in the Dinaric Karst Region include the coastal karst region from Split to Sibenik, the Patan Spring area, and the Gustirna Uvala. (See also W91-00318) (MacKeen-PTT)
W91-00325

APPLICATION OF GEOPHYSICAL METHODS TO HYDROGEOLOGICAL PROBLEMS IN DINARIC KARST OF YUGOSLAVIA.
Geophysical Institute, Belgrade, Yugoslavia.
For primary bibliographic entry see Field 7B.
W91-00326

SOME METHODS OF HYDROGEOLOGIC EXPLORATION AND WATER REGULATION IN THE DINARIC KARST WITH SPECIAL REFERENCE TO THEIR APPLICATION IN EASTERN HERZEGOVINA.
Karst Water Research Inst., Trebinje (Yugoslavia).
P. Milanovic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 160-200, 16 fig, 7 ref.

Descriptors: *Aquifer systems, *Data acquisition, *Geohydrology, *Geophysical surveys, *Groundwater management, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Water resources management, *Yugoslavia, Dinaric Karst, Geologic formations, Geology, Groundwater development, Groundwater level, Groundwater movement, Herzegovina, Hydroelectric plants, Instrumentation, Poljes, Underground streams, Water resources.

Methods of hydrogeologic exploration and water regulation in the Dinaric Karst and applications in eastern Herzegovina are reviewed. Exploration methods have included preparation of geologic maps, speleology, exploration boreholes, automatic recording instruments, radioactive tracers, geobomb, remote detection, and seismologic monitoring. The evolution process of karst collectors can be divided into two global stages, pre-Savian and neotectonic, with two periods, the Pliocene-Pleistocene period, and the end of the Pleistocene period (the recent period). Basic geohydrologic parameters of the karst areas of Montenegro, eastern Herzegovina and coastal Dubrovnik are: (1) high outflow coefficient (0.7-0.8); (2) porosity of karstified rock of 0.79% to as high as 6-10%; (3) depth of karstification of surface to 15 m for most of the mass, with a base at 250 m; (4) large fluctuations in water levels; (5) underground water flow rates of 0.002-55.2 cm/s (average 0.5-0.9 cm/s); and (6) infiltration and discharge zones. The Fatnicko and Dabarsko Poljes, the Bregava River, the Popovo Polje, and the Buna River Spring described. Exploration and water regulation projects undertaken in the area include the closing of the Obod Estavella by concrete plug, the submersion of the Trebisnjica River sources, and the study of the 'Hutovo' accumulation. The construction of the first phase of the Trebisnjica Hydro-System has greatly changed the regime of surface and underground waters in the eastern Herzegovina region and in the Dubrovnik littoral belt and Neretva River Valley. (See also W91-00318) (MacKeen-PTT)
W91-00327

HYDROGEOLOGIC FEATURES OF TYPICAL KARST TERRAINS IN MONTENEGRO.
Institute of Geological Research, Titograd, Yugoslavia.
V. Radulovic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 201-227, 18 fig.

Descriptors: *Aquifer systems, *Dinaric Karst, *Geohydrology, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Springs, *Yugoslavia, Flooding, Geologic formations, Geology, Groundwater development, Groundwater movement, Groundwater pollution, Montenegro, Poljes, Potable water, Surface-groundwater relations, Underground streams, Water resources, Water table.

The major part of the territory of Montenegro belongs to the high karst zone, which is very complex. Hydrogeologic features of the terrain include Niksicko Polje region, representing a system of large and small tectonic folds, the Gornja Zeta catchment area, comprising rocks of

the Paleozoic Mesozoic and Cenozoic age, extended areas of Quaternary sediments, surface springs and ponors. There is 80% inflow in autumn and spring, periodic flooding and large oscillations in the water table. The location of karst springs in the region is detailed. Concentration of population in the Niksicko Polje and industrial development have resulted in pollution of the soil and groundwater in the area. While there is lack of potable water during dry seasons of the year all along the periphery of the Boka Kotorska Bay, during the rainy seasons, abrupt discharge of groundwater from dispersed karst water bodies produces severe damages. (See also W91-00318) (MacKeen-PTT)
W91-00328

HYDROGEOLOGICAL FEATURES OF SOME NORTHERN DALMATIA LITTORAL KARST PARTS, LIKA AND CROATIAN LITTORAL.
Institute of Geology, Zagreb (Yugoslavia).
F. Fritz, S. Bahun, B. Biondic, A. Polsak, and Z. Vulic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 228-239, 2 fig.

Descriptors: *Aquifer systems, *Dinaric Karst, *Geohydrology, *Groundwater movement, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Yugoslavia, Dalmatia, Geologic formations, Geology, Groundwater development, Groundwater management, Hydroelectric plants, Littoral zone, Sinkholes, Springs, Water resources.

A description of the geohydrologic features of northern Dalmatia karst terrain is presented. The terrain of this low coastal region of Ravni Kotari is composed of a series of parallel northwest to southeast folds. Groundwater circulates through permeable deposits of Cretaceous carbonate and Eocene formaminifere limestone. The Middle Eocene flysh as a whole is water impermeable. Sea level fluctuation in the past 25,000 years is an important factor in karst features development and sea water intrusion. Important geohydrologic features of the region include: (1) Velebit Mountain, characterized by specific karst morphology and now a protected region,; (2) Lake Vranjsko, 30 sq m in area and 4-5 m deep, it is partitioned from the sea by a mountain ridge of Cretaceous and Eocene limestone; (3) the Obrovac Power Plant, a reversible type of plant under construction; (4) the Tucic Ponor, which absorbs flood waters from the Ricica watershed during the rainy season; (5) the Plitvicka Jezera Lakes, a National Park since 1949; (6) the Kruscica Accumulation Basin, which contains 140 million cu m of water and utilizes the Lika and Gacka Rivers for hydropower and agriculture; (7) Horvatova and Poljakova Pecina Caves, both extensively karstified; (8) Perinka Ponor, one in a series of 20 ponors on the northern slopes of Velebit Mountain; (9) submarine and coastal springs at Jurjevo, at the foot of the northern slope of Velebit; (10) the Bay of Baka, 280 l/s underground water was captured; and (11) Zwir II Water Catchment, designed for catchment of water from the springs on the right bank of the Rjecina River. (See also W91-00318) (MacKeen-PTT)
W91-00329

HYDROGEOLOGIC FEATURES OF SOME KARST PARTS OF SLOVENIA.
Institute for Karst Research, Postojna (Yugoslavia).
R. Gospodaric.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 240-254, 6 fig.

Descriptors: *Aquifer systems, *Dinaric Karst, *Geohydrology, *Groundwater resources, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, Caves, Geohydrologic units, Geologic formations, Geology, Groundwater development, Groundwater movement, Slovenia, Springs, Surface-groundwater relations, Water resources, Yugoslavia.

Geohydrologic features of Slovenia, in northwestern Yugoslavia, were examined. In this region, the geologic structure and hydrogeologic units of Dinaric Karst become more narrow, and in the northwest they disappear under alluvium of Furlania, while on the other side the alpine karst of the Julian Alps begins. The caves in through-flow karst developed mostly on the level of karst rivers, as assessed by direct water tracing methods. Indirect methods were used to delineate the zones of shallow and deep karst. Important geohydrologic features of the region include: (1) the Novokracine Blind Valley, developed in the passage of Eocene flysh to Paleocene and Cretaceous limestones; (2) the Pivka Basin of Ilirska Bistrica, characterized by periodic lakes and karst springs and shallow, through-flow karst; (3) Postojna Cave System, where the Pivka River sinks underground; (4) Skocjanske Jame and Divaca Karst, caves typical of deep, contact karst; (5) Lipica, classical karst area with important natural and tourist functions; (6) karst groundwater near Brestovica, pumped from heterogeneous karst aquifers without significantly lowering the groundwater level; (7) Mrzlek Karst Springs, exploited for water supply; (8) Karst Spring Boka in Soca River Valley; and (9) Bled, a tourist town with glacial relief forms, moraines and terraces of glacial and fluvioglacial sediments. (See also W91-00318) (MacKeen-PTT)
W91-00330

GEOHYDROLOGY AND REGIONAL GROUND-WATER FLOW OF THE COASTAL LOWLANDS AQUIFER SYSTEM IN PARTS OF LOUISIANA, MISSISSIPPI, ALABAMA, AND FLORIDA--A PRELIMINARY ANALYSIS.
Geological Survey, Baton Rouge, LA.
A. Martin, and C. D. Whiteman.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 88-4100, 1989. 88p, 63 fig, 2 tab, 67 ref, 2 plates in pocket.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Coastal aquifers, *Geohydrology, *Groundwater movement, *Regional Aquifer-Systems Analysis, Alabama, Florida, Louisiana, Mississippi, Regional analysis.

The Coastal Lowlands aquifer system of Louisiana, Mississippi, Alabama, and Florida consists of alternating, discontinuous beds of sand, gravel, silt, and clay of Miocene age and younger. The sediments thicken and dip toward the Gulf of Mexico and are highly heterogeneous. The Coastal Lowlands aquifer system has been subdivided into five regional aquifers defined on the basis of water level and pumpage data largely from heavily pumped areas. These aquifers from youngest to oldest are: The upper Pleistocene aquifer, the lower Pleistocene-upper Pliocene aquifer, the lower Pliocene-upper Miocene aquifer, the middle Miocene aquifer, and the lower Miocene aquifer. Electric logs of 279 wells were analyzed to construct maps of aquifer thickness, sand and clay content, and dissolved-solids concentrations of interstitial water. Analysis of the hydraulic characteristics of the regional aquifers indicates that the upper Pleistocene aquifer has the highest lateral hydraulic conductivity and the lower Miocene aquifer has the lowest. A six-layer finite-difference groundwater flow model was used to investigate and quantify the regional groundwater flow of the Coastal Lowlands aquifer system. The model was calibrated to match 1980 steady state conditions. Results indicate that pumpage from the Coastal Lowlands aquifer system exerts a major effect on the system under 1980 conditions; about 66% of the water that entered the flow system was discharged by pumpage. Regional groundwater flow under predevelopment conditions was primarily from recharge areas in central and southeastern Louisiana and southwestern Mississippi toward discharge areas along the gulf coast and in the major river valleys. Pumping for industry, public supply, and irrigation has produced cones of depression that distort or reverse the predevelopment flow pattern. (Author's abstract)
W91-00332

HYDROGEOLOGY AND GROUND-WATER-QUALITY CONDITIONS AT THE GEARY COUNTY LANDFILL, NORTHEAST KANSAS, 1988.
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-00338

HYDROGEOLOGY AND SIMULATION OF GROUND-WATER FLOW AT SUPERFUND-SITE WELLS G AND H, WOBURN, MASSACHUSETTS.
Geological Survey, Boston, MA. Water Resources Div.
V. de Lima, and J. C. Olimpio.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4059, 1989.

Descriptors: *Geohydrology, *Groundwater movement, *Hydrologic models, *Landfills, *Massachusetts, *Path of pollutants, *Superfund sites, *Wells, Aquifer characteristics, Aquifer testing, Model testing, Sensitivity analysis, Transmissivity.

The area around wells G and H, two former public supply wells for Woburn, MA, and currently designated as an Environmental Protection Agency 'Superfund' site, was the focus of intensive hydrogeologic investigations. Wells G and H and two nearby industrial supply wells were constructed in a stratified drift aquifer ranging in width from 0.5 to 1 mile and as much as 90 ft thick. The transmissivity of the aquifer in the vicinity of wells G and H ranges from 11,500 to 14,000 sq ft/day, and the aquifer can sustain well yields of as much as 700 gallons per minute. Recharge to the aquifer is from precipitation. Under normal conditions, with only the industrial supply wells pumping, groundwater discharges to the stream in most of the study area, and the river is a gaining stream throughout the year. When wells G and H are also pumped simultaneously, infiltration of surface water significantly decreases streamflow in the area. A three-dimensional groundwater flow model of the aquifer in the vicinity of wells G and H was designed and calibrated. The model represents an 0.8-sq-mile area and consists of nearly 5,000 active nodes in three model layers. Throughout all model layers in the center of the model area, simulated hydraulic heads matched observed and estimated hydraulic heads to within 1 ft. Throughout the remainder of the model area, hydraulic heads matched within 5 ft except in some corners and sides near till-bedrock boundaries. Under steady-state conditions, the simulated gain in streamflow was 0.27 cu ft/s, which is within the range of gains (0.1 to 0.62 cu ft/s) measured during low-flow conditions. Under transient conditions, simulated streamflow losses were 1.25 cu ft/s at the end of a 30-day aquifer test during which withdrawals averaged 3.05 cu ft/s. Sensitivity tests of the calibrated model were conducted to determine if the differences between simulated and observed/estimated data values could be attributed to the range of uncertainty in the values of input data and boundary conditions. Test results indicate that the model is least sensitive to variations in model boundary conditions, river stage, and recharge, and most sensitive to variations in storage coefficients, and order-of-magnitude changes in transmissivity and streambed conductance. (Author's abstract)
W91-00340

AVAILABILITY AND HISTORICAL DEVELOPMENT OF GROUND-WATER RESOURCES OF LONG ISLAND, NEW YORK--AN INTRODUCTION.
Geological Survey, Syosset, NY. Water Resources Div.
B. Nemickas, G. E. Mallard, and T. E. Reilly.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 88-4113, 1989. 43p, 14 fig, 4 tab, 26 ref.

Descriptors: *Groundwater availability, *Groundwater data, *Groundwater quality, *Long Island, *New York, *Water resources data, *Water resources development, Aquifer characteristics, Groundwater pollution, Leachates, Saline water intrusion, Water pollution treatment.

Groundwater is one of Long Island's most valuable natural resources. Without it, the extensive growth of population and industry that have occurred on the island since the 1940's would not have been possible. The present population, with its industry and agriculture, will continue to require a supply of high-quality water in the future. Several past human activities have adversely affected this resource; for example, excessive pumping in some areas has caused saltwater intrusion, plumes of leachate from solid-waste landfills have caused local contamination of the aquifers, cesspool discharges have caused nitrate contamination of groundwater, and application of pesticides has caused groundwater contamination in eastern Suffolk County. Some of the problems can be or have been corrected or avoided through proper management. Proper management requires an understanding of the basic laws of physics and chemistry that govern the occurrence and movement of groundwater and associated chemical constituents; it also requires information on the geometry, hydraulics, and natural chemical quality of the Long Island system. Techniques for studying this hidden resource include collection of groundwater samples and water-level data at wells to define the hydraulics and chemistry of the system, and then interpretation and refinement of this information through techniques such as computer simulation. Four case studies of human-induced contamination of the groundwater system show how knowledge of the problem and of the hydrologic system can lead to appropriate responses. For these cases, the responses were: (1) importation of water to reduce or stop saltwater intrusion in Kings and Queens counties; (2) installation of sanitary sewers to avoid groundwater contamination by domestic waste-disposal systems; (3) improved design, management, and operation of landfills to prevent the formation and entry of leachate into the underlying groundwater; and (4) bans on the use of a certain pesticide and temporary treatment of the pumped water until pesticide concentrations were lowered through dilution (flushing) and degradation. All four responses were different, yet appropriate. (Shidler-PTT)
W91-00345

GEOHYDROLOGIC ASPECTS FOR SITING AND DESIGN OF LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL.
For primary bibliographic entry see Field 5E.
W91-00347

GEOHYDROLOGY AND SIMULATED EFFECTS OF PUMPAGE ON THE NEW ORLEANS AQUIFER SYSTEM AT NEW ORLEANS, LOUISIANA.
Geological Survey, Baton Rouge, LA.
D. C. Dial, and D. M. Sumner.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water Resources Technical Report No. 46, 1989. 54p, 1 plate, 32 fig, 4 tab, 36 ref. Prepared in cooperation with Louisiana Department of Transportation and Development.

Descriptors: *Aquifer systems, *Geohydrology, *Louisiana, *Model studies, *New Orleans Aquifer System, *Pumpage, *Simulation analysis, Mathematical models, Saline water intrusion, Subsidence, Water supply.

The New Orleans Aquifer System was evaluated as an alternative public-supply source for New Orleans. It is the only aquifer system that contains a large volume of freshwater beneath the city. It consists of a series of alternating beds of sand and clay that deepen southward toward the Gulf of Mexico. The aquifer system includes the Gramercy, Norco, Gonzales-New Orleans, and '1,200-foot' aquifers, and the intervening clay beds. Hydraulic conductivities of the aquifers range from 100 to 130 feet per day and storage coefficients average about 0.0005, based on aquifer-test results. Aquifer-test data are unavailable for the '1,200-foot' aquifer. Confining-unit hydraulic conductivities were based on their depth of burial. A three-dimensional finite-difference groundwater flow model was used to evaluate the New Orleans Aquifer System. The model was calibrated by comparing observed and computed water levels for the period 1900 to 1981. Differences of 20 feet or less were observed for most of the modeled area. The model was used to predict the effects of pumping on water levels and saltwater encroachment. Flow within the aquifer system was simulated for the period 1987-2006 at the 1986 pumping rate of 40 Mgal/d (million gallons per day) and with an increase of 130 Mgal/d over the 1986 rate. The first simulation showed a gradual recovery over the 20-year period. The lowest water level at the end of 20 years was 90 feet below sea level near Michoud. The second simulation showed a maximum decline of 410 feet below sea level near the lakefront at Lake Pontchartrain. Dewatering of the aquifer could possibly occur as a result of increased pumping, but its effect is of little significance. The increased pumpage required to supply New Orleans (130 Mgal/d superimposed on the present pumpage of 40 Mgal/d) would cause saltwater to move more rapidly toward the areas of pumping. The rate of encroachment in the Industrial Canal area would be about 500 feet per year and in the Michoud area about 250 feet per year. The Gonzales-New Orleans aquifer has the capability to supply the needs of New Orleans but certain problems need to be addressed such as the effect of water-level decline on subsidence and the control of saltwater encroachment. (Author's abstract)
W91-00348

GROUND-WATER HYDROLOGY OF THE CENTRAL RATON BASIN, COLORADO AND NEW MEXICO.
Geological Survey, Arvada, CO.
A. L. Geldon.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Supply Paper 2288. 81p, 62 fig, 15 tab, 68 ref. Prepared in cooperation with the U.S. Bureau of Land Management.

Descriptors: *Colorado, *Geohydrology, *Groundwater basins, *Groundwater potential, *New Mexico, *Raton Basin, Aquifer characteristics, Coal mines, Groundwater chemistry, Groundwater quality.

The watersheds of the Purgatoire and Apishapa Rivers contain most of the public coal lands in the Raton Basin. From 1978 to 1982, 231 wells, 38 springs, and 6 mines were inventoried, and groundwater samples were collected from 71 sites. The Raton Basin is an asymmetrical trough, containing 10,000 to 25,000 feet of sedimentary rocks that range in age from Pennsylvanian to Eocene. These rocks are intruded by Miocene igneous rocks, covered with Pleistocene and Holocene alluvium, and underlain by Precambrian crystalline rocks. Bituminous coal occurs in the Vermejo and Raton Formations of Cretaceous and Paleocene age. Virtually all of the sedimentary rocks transmit water. Stream alluvium is the most productive aquifer. Bedrock aquifers have smaller yields but greater distribution. The principal bedrock aquifers are the Cuchara-Poison Canyon and the Raton-Vermejo-Trinidad. Other formations are nearly impermeable or too deep to be utilized economically. Water in alluvium typically is less mineralized than in bedrock but more susceptible to contamination. Sodium and calcium bicarbonate waters predominate in the area, but sodium chloride water commonly occurs in the Cuchara-Poison Canyon aquifer and may occur in the Pierre Shale. Plumes of sulfate-enriched water extend from coal mines into bedrock and alluvial aquifers. Dissolved-solids concentrations range from less than 500 milligrams per liter in calcium bicarbonate water to more than 1,500 milligrams per liter in sulfate and chloride waters. Much of the groundwater is hard. Nitrogen is enriched in shallow groundwate , and fluoride is enriched in deeper groundwater. Levels of iron, manganese, zinc, and selenium locally exceed standards for domestic consumption. The Purgatoire River and its tributaries are predominantly gaining streams, but losing reaches occur. Water quality in streams is affected by tributary inflows, mine discharge, contact with and seepage from tailings, groundwater seepage, diversion ditches, and changes in stage. Groundwater flows regionally from west to east and locally from stream divides to valleys. Depths to water vary from 500 feet beneath divides to less than 100 feet in valleys. Groundwater supplies probably are insufficient for expanded settlement and coal mining. (Author's abstract)
W91-00349

STATISTICAL PROCESSOR FOR ANALYZING SIMULATIONS MADE USING THE MODULAR FINITE-DIFFERENCE GROUND-WATER FLOW MODEL.
Geological Survey, Oklahoma City, OK.
For primary bibliographic entry see Field 7C.
W91-00353

ANALYSIS OF GEOPHYSICAL WELL LOGS AND FLOWMETER MEASUREMENTS IN BOREHOLES PENETRATING SUBHORIZONTAL FRACTURE ZONES, LAC DU BONNET BATHOLITH, MANITOBA, CANADA.
Geological Survey, Lakewood, CO.
F. L. Paillet.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4211, 1989. 30p, 13 fig, 30 ref.

Descriptors: *Borehole geophysics, *Flow measurement, *Geohydrology, *Geologic fractures, *Groundwater movement, *Manitoba, *Well logs, Canada, Flowmeters, Fracture permeability, Geologic formations, Pumping tests.

Sensitive thermal-pulse flowmeter measurements and various geophysical well logs were obtained in boreholes penetrating regional fracture zones in a granitic batholith at a location on the southwestern margin of the Canadian shield. Flowmeter measurements were made in a pair of boreholes 130 meters apart, shown by geophysical logs to intersect an isolated fracture zone about 270 meters in depth. Flow measurements made before start of the pumping test indicated no flow in one borehole; periodic flow in the other borehole was related to irregular drawdowns near the bottom of casing, causing inflow adjacent to the deep fracture zone, and outflow at a point less than 30 meters in depth. Pumping tests were made on each of the boreholes produced from a single set of fractures within or splaying off the major fracture zone at 270 meters in depth. However, flow occurred between the boreholes along intersecting fractures a few meters beneath the major fracture zone during cross-hole pumping tests made by maintaining a constant hydraulic-head difference of about 80 meters. Additional flowmeter measurements were made without pumping in a third borehole located approximately 5 kilometers east of the two boreholes used for the pumping tests. Flowmeter measurements indicated flow along the borehole between two individual sets of fractures within a major fracture zone located along the contact of the batholith with surrounding gneiss. In two instances, acoustic tube-wave amplitude attenuation indicated substantial fracture permeability even though other geophysical well logs and core inspection confirmed the presence of an unfractured layer of contrasting acoustic properties. Borehole-wall breakouts indicative of substantial stress anisotropy were identified on the geophysical well logs for two of the boreholes used in this study and corresponded almost exactly with the distribution of core disking in one of these boreholes. This could indicate that local stress concentration in the vicinity of fracture zones caused opening or reopening of some of the most favorably oriented fractures. (Author's abstract)
W91-00354

GROUND-WATER RESOURCES OF THE ARKANSAS RIVER BASIN IN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
J. M. Kilpatrick, and A. H. Ludwig.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 88-725, 1990. 45p, 12 fig, 13 tab, 34 ref. Prepared in cooperation with the U.S. Army Corps of Engineers.

Descriptors: *Aquifer characteristics, *Arkansas, *Groundwater potential, *Groundwater resources, *River basins, *Water resources data, Arkansas River Basin, Geologic formations, Geomorphology, Groundwater pollution, Groundwater quality.

The Arkansas River basin in Arkansas lies almost entirely within the Interior Highlands physiographic division. The Interior Highlands consist of hilly to mountainous terrain underlain by sandstone, shale, limestone, and dolomite. Significant water-yielding units within the Arkansas River basin in Arkansas include subsurface Paleozoic rocks such as the Eminence and Potosi Dolomites, the Gasconade Dolomite and the Van Buren Formation, and Roubidoux Formation as well as outcrops of Paleozoic rocks, the Sparta Sand, and Quaternary deposits. Groundwater withdrawals in the 15-county area approximating the study area totaled 257 million gallons per day in 1985. More than 70 percent of this total was withdrawn from the Sparta Sand and the Quaternary deposits in the Coastal Plain. Less than 10 percent was withdrawn from the Paleozoic units that underlie the Interior Highlands. The quality of groundwater withdrawn from the various aquifers in the study area generally is suitable for most uses. With the exception of the Sparta Sand, the major aquifers yield water that is commonly very hard and highly mineralized. Yields from the different water-bearing units are highly variable. Several of the subsurface Paleozoic formations yield as much as 450 gallons per minute, whereas outcrops of Paleozoic rocks rarely yield more than 10 gallons per minute. In the Coastal Plain, the Sparta Sand and the Quaternary deposits yield as much as 2,000 and 2,500 gallons per minute, respectively. In the northern part of the study area, the extensive fracturing of formation outcrops makes them more susceptible to contamination from the surface. Several studies have identified localized bacterial contamination of water from both wells and springs in this part of the study area. Nitrate concentrations exceeding U S Environmental Protection Agency primary drinking water standards have occurred in some areas. No areas within the study area met the critical-use criteria established by the Arkansas Soil and Water Conservation Commission. Potential groundwater problems include potential contamination from one Resource Conservation and Recovery Act site, two Comprehensive Environmental Response, Compensation, and Liability Act sites, and numerous landfills and surface impoundments. (Author's abstract)
W91-00355

GROUND-WATER DATA FOR MICHIGAN 1988.
Geological Survey, Lansing, MI.
G. C. Huffman, and C. R. Whited.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 89-597, 1989. 54p, 4 fig, 4 tab, 119 ref. Prepared in cooperation with the Michigan Department of Natural Resources Geological Survey Division.

Descriptors: *Groundwater, *Groundwater resources, *Hydrologic data, *Michigan, *Water resources data, Aquifers, Observation wells, Water level, Water use.

Water levels, locations, depths, and aquifers tapped are given for 112 observation wells. Tabulated data include a listing of groundwater reports in Michigan, extremes of water levels for calendar year 1988 and for the period of record, pumpage of most major groundwater users in the State, and water-quality data from selected wells. The two largest municipal users of groundwater, were the cities of Lansing and Kalamazoo. In 1988, Lansing pumped 7.8 billion gallons from the Saginaw Formation and glacial deposits and Kalamazoo pumped 7.4 billion gallons from glacial deposits only. (Author's abstract)
W91-00358

GRAPHICAL KERNEL SYSTEM (GKS) VERSION OF COMPUTER PROGRAM MODPATH-PLOT FOR DISPLAYING PATH LINES GENERATED FROM THE U.S. GEOLOGICAL SURVEY THREE-DIMENSIONAL GROUND-WATER FLOW MODEL.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W91-00361

WHAT IS A LEACHER.
Biospherics, Inc., Beltsville, MD. Ground Water and Environmental Programs.
For primary bibliographic entry see Field 5B.
W91-00362

HIGH WATER LEVEL INSTALLATION OF MONITORING WELLS FOR UNDERGROUND STORAGE TANKS.
For primary bibliographic entry see Field 5G.
W91-00364

SUBSURFACE TRANSPORT OF INORGANIC AND ORGANIC SOLUTES FROM EXPERIMENTAL ROAD SPREADING OF OIL-FIELD BRINE.
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
For primary bibliographic entry see Field 5B.
W91-00365

PROPOSAL TO USE CHLORINE-36 FOR MONITORING THE MOVEMENT OF RADIONUCLIDES FROM NUCLEAR EXPLOSIONS.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 5A.
W91-00366

MODELING THE POTENTIAL EFFECT OF ADDITIVES ON ENHANCING THE SOLUBILITY OF AROMATIC SOLUTES CONTAINED IN GASOLINE.
Michigan Technological Univ., Houghton. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W91-00369

REMOTE DATA COLLECTION AND CONTROL FOR HYDROGEOLOGIC MONITORING.
CH2M Hill Engineering, Waterloo (Ontario).
For primary bibliographic entry see Field 7B.
W91-00370

WATER WATER EVERYWHERE . . . HAVE YOU LOOKED.
BCI Geonetics, Inc., Laconia, NH.
A. W. Stone.
Water Well Journal WWJOA9, Vol. 44, No. 6, p 48-49, June 1990.

Descriptors: *Groundwater availability, *Groundwater management, *Groundwater potential, *Groundwater resources, *Water management, *Water supply development, Decision making, Surface water, Water demand, Water supply.

In looking for ways to satisfy the ever increasing demands on the drinking water supply, there may be supply options available about which resource managers are unaware, or have underestimated. One option that appears to be frequently overlooked and underestimated is groundwater resources. Despite the fact that enormous opportunity for groundwater resource development exists and that many of the sophisticated surface water options are at the limit of engineering ingenuity and hydrological potential, groundwater resource development remains hindered by a surface water mind-set and inaccurate perceptions about the groundwater supply perpetuated by the results of myopic investigations undertaken many years ago. However, these attitudes and perceptions must be challenged if a resource manager is to provide the best chance of creating solutions to perceived or real water deficits. This can only be accomplished by supplying a thorough knowledge of all supply options. In many areas and in many parts of the world, a quantification of the real ground water potential is the missing link in a total integrated management strategy. Therefore, it is imperative that a full assessment of groundwater potential be at the top of the decision-making checklist. (Fleishman-PTT)
W91-00412

RESEARCH ON AGRICHEMICALS IN WATER RESOURCES.
Geological Survey, Iowa City, IA.
For primary bibliographic entry see Field 5B.
W91-00417

GROUND-WATER CONDITIONS IN LAS VEGAS VALLEY, CLARK COUNTY, NEVADA. PART 1: HYDROGEOLOGIC FRAMEWORK.
Geological Survey, Carson City, NV.
R. W. Plume.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Water-Supply Paper 2320-A, 1989. 15p, 5 pl, 2 fig, 1 tab, 36 ref. Prepared in cooperation with the Clark County Department of Comprehensive Planning.

Descriptors: *Aquifer characteristics, *Geohydrology, *Groundwater basins, *Groundwater resources, *Las Vegas Valley, *Nevada, Geologic formations, Geologic history, Geological surveys, Lithology, Sedimentary basins.

Las Vegas Valley, Nevada, is a structural basin formed by bedrock that ranges in age from Precambrian through Miocene. Gravity data indicate that the deeper parts of the basin are filled with 3,000-5,000 ft of clastic sedimentary deposits that range in age from Miocene through Holocene. These deposits constitute the valley-fill aquifer and yield most of the water pumped in the valley. The upper 1,000 ft of this valley fill consist of coarse-grained deposits (sand and gravel), fine-grained deposits (silt and clay), and heterogeneous deposits that comprise either thinly interbedded coarse-grained and fine-grained deposits or mixtures of the two. Coarse-grained deposits, in places more than 1,000 ft thick, underlie the south and west sides of the valley and interfinger with fine-grained and heterogeneous deposits toward the center of the valley. Intervals of fairly thin heterogeneous deposits underlie parts of the valley, but they are not laterally persistent. The bedrock basin that underlies Las Vegas Valley consists of a deeply-buried part that underlies most of the valley and a shallow bedrock surface on the west side of the valley. The deep part of the basin is bounded on the east by normal faults at the base of Frenchman Mountain, on the west by a possible normal fault that coincides with a zone of fault scarps, on the north by vertical or strike-slip displacement along the Las Vegas shear zone, and on the northwest by a bedrock high that underlies the area between Tule Springs and Corn Creek Springs. The shallow bedrock surface (as much as 1,000 ft deep) underlies the west side of the valley from La Madre Mountain to the McCullough Range. Some of the fault scarps in the valley fill coincide with possible bedrock faults, which suggests a tectonic origin for some of the faulting of valley-fill deposits; however, the area of fault scarps on the west side of the valley also coincides with a rapid lateral change from incompressible bedrock to more compressible valley-fill deposits. Thus, both differential compaction and tectonic movement may be responsible for faulting of valley-fill deposits. (Author's abstract)
W91-00429

GEOCHEMISTRY OF IRON IN A SAND DUNE AQUIFER, NEAR COOS BAY AND NORTH BEND, OREGON.
Geological Survey, Portland, OR.
For primary bibliographic entry see Field 2K.
W91-00430

GROUND-WATER DATA FOR GEORGIA, 1988.
Geological Survey, Doraville, GA.
C. N. Joiner, M. F. Peck, M. S. Reynolds, and W. L. Stayton.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 89-408, 1989. 176p, 84 fig, 62 ref. Prepared in cooperation with the Georgia Department of Natural Resources, Environmental Protection Division, Georgia Geologic Survey.

Descriptors: *Georgia, *Groundwater data, *Groundwater level, *Groundwater quality, *Hydrologic data, *Subsurface mapping, *Water resources data, Aquifer characteristics, Drought effects, Hydrographs, Water sampling, Wells.

Continuous water-levels records from 144 wells and water-level measurements from an additional 617 wells in Georgia during 1988 provide the basic data for this report. Daily mean water-level hydrographs for selected wells illustrate the effects that changes in recharge and discharge have had on the groundwater reservoirs in the State during 1988. Monthly mean water levels are shown for the 10-year period 1979-88. Maps showing the potentiometric surface of the Upper Floridan aquifer for May 1988 and the Claiborne and Clayton aquifers for October 1988 also are presented. Annual mean water levels in Georgia generally were below those measured in 1987; water levels ranged from 6.9 ft higher to 7.3 ft lower. Record-low water levels were measured during the last half of 1988 in 18 wells tapping the crystalline rock aquifer, the Cretaceous rock aquifer system, the Midville aquifer system, and the Clayton, Upper Floridan, and upper Brunswick aquifers. These record lows were from 0.1 to 1.4 ft lower than the previous record lows. A prolonged drought resulted in decreased recharge to the aquifers and increased groundwater pumping, which caused water levels to decline. Water quality samples collected periodically throughout Georgia are analyzed as part of areal and regional groundwater studies. Maps showing chloride concentrations in the Upper Floridan aquifer in October 1988 in coastal Georgia and in the Savannah and Brunswick areas are presented. Periodic monitoring of water quality in the Savannah and Brunswick areas indicates that chloride concentrations in the Upper Floridan generally have remained stable. (Author's abstract)
W91-00432

HYDROGEOLOGY AND WATER QUALITY OF SIGNIFICANT SAND AND GRAVEL AQUIFERS IN PARTS OF AROOSTOOK COUNTY, MAINE: SIGNIFICANT SAND AND GRAVEL AQUIFER MAPS 75, 76, 77, 78, 84, AND 85.
Maine Dept. of Environmental Protection, Augusta.
D. B. Locke, J. I. Steiger, T. K. Weddle, and C. D. Neil.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 89-1a, 1989. 88p, 13 plates, 7 fig, 14 tab, 81 ref.

Descriptors: *Geohydrology, *Glacial aquifers, *Groundwater resources, *Hydrologic data, *Maine, *Subsurface mapping, *Water quality, *Water resources data, Alluvial deposits, Geological surveys, Sand aquifers, Well yield.

A reconnaissance-level hydrogeologic study was made of 2139 sq mi in Aroostook County, Maine. Maps 75, 76, 77, 78, 84, and 85 of the Significant Sand and Gravel Aquifer Map Series published by the Maine Geological Survey cover the study area. The significant sand and gravel aquifers consist of glacial ice-contact, ice-stagnation, outwash, and alluvial deposits found primarily in the valleys of the major river systems and their tributaries and near other surface-water bodies. By definition, significant aquifers are capable of yielding more than 10 gal/min to a properly constructed well. Significant aquifers comprise approximately 111 sq mi (5%) of the study area; yields estimated to exceed 50 gal/min are believed to be available from only 1.5 sq mi (less than 1%) of the area. Typically, the water table is within 15 ft of land surface. On the basis of well records, the greatest known depth to bedrock exceeds 214 ft. The greatest known well yield is approximately 1,710 gal/min from a gravel-packed well owned by a food processing company. The regional groundwater quality ranges from acidic to slightly basic; calcium, sodium, and magnesium are the most abundant cations; bicarbonate is the most abundant anion; and the water generally is hard. In some locations, concentrations of iron and manganese are large enough to limit the suitability of untreated water for some uses. (Author's abstract)
W91-00435

HYDROGEOLOGIC AND WATER-QUALITY DATA FROM WELL CLUSTERS NEAR THE WASTEWATER-TREATMENT PLANT, U.S. MARINE CORPS AIR STATION, CHERRY POINT, NORTH CAROLINA.
Geological Survey, Raleigh, NC.
For primary bibliographic entry see Field 5B.
W91-00438

HYDROLOGIC AND CHEMICAL DATA FROM SELECTED WELLS AND SPRINGS IN SOUTHERN ELMORE COUNTY, INCLUDING MOUNTAIN HOME AIR FORCE BASE, SOUTHWESTERN IDAHO, FALL 1989.
Geological Survey, Boise, ID.
For primary bibliographic entry see Field 5B.
W91-00440

WATER LEVELS IN PERIODICALLY MEASURED WELLS IN THE YUCCA MOUNTAIN AREA, NEVADA, 1988.
Geological Survey, Denver, CO.
J. M. Gemmell.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 90-113, 1990. 47p, 2 fig, 2 tab, 14 ref. Prepared in cooperation with the Nevada Operations Office. DOE Interagency Agreement DE-A108-78ET44802.

Descriptors: *Groundwater data, *Groundwater level, *Nevada, *Radioactive waste disposal, *Wells, Hazardous waste disposal, Hydrographs, Saturation zone, Underground waste disposal, Yucca Mountain.

This report presents water level data for 10 wells that were periodically measured in 1988 in the Yucca Mountain area, Nevada. Water levels measured during 1987 are included in the report for reference. The report includes discussions of the methods used and corrections applied to obtain water level depths and altitudes from onsite measurements. Water levels for each well are presented in tabular and graphical (hydrographs) form. The altitude of the water level in the upper part of the saturated zone is about 775 meters above sea level to the west of and along part of the crest of Yucca Mountain; along the eastern edge and southern end of Yucca Mountain, the water level is 728 to 730 meters above sea level. The water level data were obtained to help evaluate the suitability of the area for storing high-level nuclear waste. (Author's abstract)
W91-00441

FATE AND TRANSPORT OF PETROLEUM RELEASED FROM UNDERGROUND STORAGE TANKS.
University of Southern California, Los Angeles.
For primary bibliographic entry see Field 5B.
W91-00452

CASE-CONTROL STUDY OF COLON CANCER AND VOLATILE ORGANICS IN WISCONSIN MUNICIPAL GROUNDWATER SUPPLIES.
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5C.
W91-00506

CORRELATIONS BETWEEN MEASUREMENTS OF ORGANIC HALIDE AND SPECIFIC HALOGENATED VOLATILE ORGANIC COMPOUNDS IN CONTAMINATED GROUNDWATER.
Arizona Univ., Tucson. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00528

ROLE OF STANDARDS IN IOWA'S GROUNDWATER PROTECTION PROGRAM: A REPORT TO THE IOWA GENERAL ASSEMBLY.
Iowa Dept. of Environmental Quality, Des Moines.
For primary bibliographic entry see Field 5G.
W91-00566

ROLE OF STANDARDS IN IOWA'S GROUNDWATER PROTECTION PROGRAM: A REPORT TO THE IOWA GENERAL ASSEMBLY, APPENDIX 2 - WRITTEN COMMENTS.
Iowa Dept. of Environmental Quality, Des Moines.
For primary bibliographic entry see Field 5G.
W91-00567

PESTICIDES IN GROUND WATER DATA BASE: 1988 INTERIM REPORT.
Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.
For primary bibliographic entry see Field 5B.
W91-00569

USERS MANUAL FOR THE SLUDGEMAN MODEL FOR THE GROUNDWATER PATHWAY IN THE MONOFILLING OF SEWAGE SLUDGE.
ICF Technology, Inc., Fairfax, VA.
For primary bibliographic entry see Field 5E.
W91-00575

EXACT SOLUTION FOR FLOW OF SLIGHTLY COMPRESSIBLE FLUIDS THROUGH MULTIPLE-POROSITY, MULTIPLE-PERMEABILITY MEDIA.
Scientific Research Inst. of Petroleum Exploration and Development, Beijing (China).
M. X. Liu, and Z. X. Chen.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1393-1400, July 1990. 1 fig, 15 ref.

Descriptors: *Aquifer systems, *Flow models, *Fluid flow, *Groundwater movement, *Mathematical models, *Model studies, *Porous media, Compressible flow, Permeability, Porosity, Reservoirs.

To describe the flow of fluids through a multiple aquifer system, a model was developed which describes the flow of a slightly compressible fluid through a multiple-porosity, multiple-permeability medium. The model considers flow within each porous system and the cross flow between any two different porous systems using a matrix of cross-flow coefficients. An exact solution for a bounded, closed cylindrical reservoir producing at a constant rate is obtained rigorously. The solution is expressed in terms of Bessel functions, so there are no particular difficulties in computing the solution numerically. The key to the method of solution is an orthogenal matrix transformation that makes the n-coupled governing equations uncoupled. A variety of problems of fluid flow through layered reservoirs may be obtained using the general solution and method presented by specifying the elements of the matrix of cross-flow coefficients and appropriate boundary conditions. (Author's abstract)
W91-00588

MULTILAYERED SHARP INTERFACE MODEL OF COUPLED FRESHWATER AND SALTWATER FLOW IN COASTAL SYSTEMS: MODEL DEVELOPMENT AND APPLICATION.
Geological Survey, Menlo Park, CA.
H. I. Essaid.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1431-1454, July 1990. 35 fig, 8 tab, 86 ref. U.S. Geological Survey and Universidad Politecnica de Valencia Grant CCA8309117.

Descriptors: *Coastal aquifers, *Flow models, *Saline water intrusion, *Saline-freshwater interfaces, California, Flow equations, Freshwater, Model studies, Regional analysis, Saline water, Sea level, Soquel-Aptos Basin.

Coastal aquifers are an important water resource in areas bordering seas. A quasi three-dimensional, finite difference model, that simulates freshwater and salt water flow separated by a sharp interface, has been developed to study layered coastal aquifer systems. The model allows for regional simulation of coastal groundwater conditions, including effects of salt water dynamics on the freshwater system. Vertically integrated freshwater and salt water flow equations incorporating the interface boundary condition are solved within each aquifer. Leakage through confining layers is calculated by Darcy's law, accounting for density differences across the layer. The locations of the interface tip and toe, within grid blocks, are tracked by linearly extrapolating the position of the interface. The model has been verified using available analytical solutions and experimental results. Application of the model to the Soquel-Aptos basin, Santa Cruz County, California, illustrates the use of the quasi three-dimensional, sharp interface approach for the examination of freshwater-salt water dynamics in regional systems. Simulation suggests that the interface today is still responding to long-term Pleistocene sea level fluctuations and has not achieved equilibrium with present day sea level conditions. (Author's abstract)
W91-00591

MATHEMATICAL MODELING OF TRACER BEHAVIOR IN SHORT-TERM EXPERIMENTS IN FISSURED ROCKS.
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W91-00598

EFFICIENT DETERMINISTIC-PROBABILISTIC APPROACH TO MODELING REGIONAL GROUNDWATER FLOW: 1. THEORY.
California Univ., Irvine. Dept. of Civil Engineering.
C. C. Yen, and G. L. Guymon.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1559-1567, July 1990. 5 fig, 4 tab, 25 ref.

Descriptors: *Flow models, *Geohydrology, *Groundwater movement, *Mathematical models, *Model studies, Groundwater management, Regional analysis, Unconfined aquifers, Variation coefficient, Water table fluctuations.

An efficient probabilistic model was developed and cascaded with a deterministic model for predicting water table elevations in regional aquifers. The objective was to quantify model uncertainty where precise estimates of water table elevations may be required. The probabilistic model is based on the two-point probability method which only requires prior knowledge of uncertain variables mean and coefficient of variation. The two-point estimate method was theoretically developed and compared with the Monte Carlo simulation method. The results of comparisons using hypothetical deterministic problems indicate that the two-point estimate is only generally valid for linear problems where the coefficients of variation of uncertain parameters (for example, storage coefficient and hydraulic conductivity) are small. The two-point estimate may be applied to slightly nonlinear problems with good results, provided coefficients of variation are small. In such cases, the two-point estimate method is much more efficient than the Monte Carlo method provided the number of uncertain variables is less than eight. (See also W91-00602) (Author's abstract)
W91-00601

EFFICIENT DETERMINISTIC-PROBABILISTIC APPROACH TO MODELING REGIONAL GROUNDWATER FLOW: 2. APPLICATION TO OWENS VALLEY, CALIFORNIA.
California Univ., Irvine. Dept. of Civil Engineering.
G. L. Guymon, and C. C. Yen.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1569-1581, July 1990. 12 fig, 3 tab, 12 ref.

Descriptors: *Flow models, *Geohydrology, *Groundwater movement, *Model studies, California, Mathematical models, Owens Valley, Regional analysis, Unconfined aquifers, Variation coefficient, Water table fluctuations.

The applicability of a deterministic-probabilistic model for predicting water tables in southern Owens Valley, California, was evaluated. The model is based on a two-layer deterministic model that is cascaded with a two-point probability model. To reduce the potentially large number of uncertain variables in the deterministic model, lumping of uncertain variables was evaluated by sensitivity analysis to reduce the total number of uncertain variables to three variables: hydraulic conductivity, storage coefficient or specific yield, and source-sink function. Results demonstrate that lumping of uncertain parameters reduces computational effort while providing sufficient precision for the case studied. Simulated spatial coefficients of variation for water table temporal position in most of the basin is small, which suggests that deterministic models can predict water tables in these areas with good precision. However, in several important areas where pumping occurs or the geology is complex, the simulated spatial coefficients of variation are overestimated by the two-point probability method. (See also W91-00601) (Author's abstract)
W91-00602

SPECIFIC STORAGE AS A POROELASTIC COEFFICIENT.
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
D. H. Green, and H. F. Wang.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1631-1637, July 1990. 23 ref. Petroleum Research Fund Grant 19139-AC2, Department of Energy Grant DE FG02-84ER13184.

Descriptors: *Aquifer characteristics, *Aquifers, *Compressibility, *Elasticity, *Mathematical analysis, *Specific storage, *Storage coefficient, *Theoretical analysis, Groundwater storage, Hydraulic conductivity.

A definition derived for the specific storage coefficient is unambiguous for general isotropic three-dimensional aquifer elasticity. In every representative elementary volume, the specific storage coefficient is the fluid volume released from storage per unit decline in hydraulic head, per unit bulk volume, under conditions such that there is no strain in two orthogonal directions, and the total normal stress in the third orthogonal direction is constant. The specific storage coefficient is a point property of the aquifer and is defined independently of problem domain stress and head boundary conditions. The expression for specific storage coefficient in terms of aquifer and fluid compressibilities is identical to the familiar forms obtained assuming zero horizontal strain and constant overburden in an aquifer, although it is not restricted to these conditions. As a point property of the fluid-saturated material, the specific storage coefficient is one of four constants in the general constitutive poroelastic equations relating three-dimensional aquifer stress and strain to fluid pressure and dilatation. Written in terms of specific storage coefficient, the equations showed that pore fluid mass diffusion is governed by a diffusivity equal to the ratio of hydraulic conductivity to specific storage under arbitrary boundary conditions. It is shown that specific storage coefficient controls slow compressional body wave velocity in the low frequency limit and that the uniaxial aquifer compressibility is not necessarily related to the vertical direction. (Author's abstract)
W91-00607

FLUORESCENT POLYCYCLIC AROMATIC HYDROCARBONS AS PROBES FOR STUDYING THE IMPACT OF COLLOIDS ON POLLUTANT TRANSPORT IN GROUNDWATER.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 5B.
W91-00623

SOME CHARACTERISTICS OF SPRINGS IN HIGH ELEVATION ALTERITIC MATERIAL: THEIR CONTRIBUTION TO THE UNDERSTANDING OF THE INTRICACY OF THE TWO-LAYERED 'SAND-BASEMENT' AQUIFER (MADAGASCAR HIGH PLATEAUX) (CARACTERISTIQUES D'EMERGENCES EN MILIEU ALTERITIQUE D'ALTITUDE: LEUR APPORT A LA COMPREHENSION DE L'AQUIFERE BICOUCHE ARENES-SOCLE (HAUTS PLATEAUX DE MADAGASCAR)).
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
J. C. Grillot.
Comptes Rendus de l'Academie des Sciences (Serie 2) CRASEV, Vol. 311, No. 1, p 227-232, July 5, 1990. 2 fig, 7 ref. English summary.

Descriptors: *Alpine regions, *Aquifer characteristics, *Conductivity, *Drainage, *Geohydrology, *Groundwater movement, *Springs, Alluvium, Aquifers, Bogs, Discharge measurement, Groundwater recharge, High Plateau, Infiltration, Isotope studies, Madagascar, Peat, Sand, Sediments, Water temperature.

Highly heterogeneous materials lie on the high plateau of Madagascar: sandy-silty alterites, micaceous arenites and sands, peat, boggy-silt, and alluvium. Many lowland flat bottomed areas are flooded for about 9 months of the year during which the alteritic morphology is affected. The flooding of the lowlads planted with rice is due to a line of springs generated within the alterites (free aquifer). Two such springs (S1 and S9) were monitored (water discharge, electrical conductivity, temperature, and isotopic determination of 18-O and 2-H) during a full hydrologic period. The two springs have different regimes; time-dependent variations are large for S1 and small for S9. The water electrical conductivity is low (10 microS/cm on average) and fluctuates similarly for the two springs which demonstrates the absence of interaction of the water flow with surrounding minerals. Temperatures are very similar though. During the warm and humid season (from December to May) they apparently vary as does the atmospheric temperature. This behavior can be explained by the thickness of the alterites (< 20 m) and by the amplitude of the piezometric fluctuations which put the aquifer within the heterothermal underground layer. However, the winter temperature rises during the austral winter (June to August). In the mean time, electrical conductivity values stabilize. On the S1 and S9 springs the temperature rise occurs also approximately 3 months after the end of the main rain period (March). One therefore can claim that this temperature rise is due to the upward drainage of warmer water originating from the basement. (Korn-PTT)
W91-00856

MATHEMATICAL MODELLING OF SEA WATER INTRUSION, NAURU ISLAND.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
For primary bibliographic entry see Field 2L.
W91-00865

EFFECTS OF FAULTS ON FLUID FLOW AND CHLORIDE CONTAMINATION IN A CARBONATE AQUIFER SYSTEM.

Geological Survey, Doraville, GA. Water Resources Div.
M. L. Maslia, and D. C. Prowell.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 1-49, July 1990. 15 fig, 4 tab, 45 ref.

Descriptors: *Aquifer characteristics, *Chlorides, *Geohydrology, *Georgia, *Groundwater chemistry, *Groundwater movement, *Groundwater pollution, *Model studies, *Saline water intrusion, Data analysis, Floridan Aquifer, Flow models, Geologic fractures, Groundwater availability, Groundwater management, Groundwater quality, Mathematical models, Potentiometric surface, Pumpage.

Water resources managers have been assigned the responsibility of understanding and predicting the effect of large withdrawals of groundwater on the aquifer systems. A unified, multidiscipline hypothesis is proposed to explain the anomalous pattern by which chloride has been found in water of the Upper Floridan aquifer in Brunswick, Glynn County, Georgia. Analyses of geophysical, hydraulic, water chemistry, and aquifer test data using the equivalent porous medium approach are used to support the hypothesis and to improve further the understanding of the fracture-flow system in this area. The data presented show that: (1) four major northeast-southwest trending faults, capable of affecting the flow system of the Upper Floridan aquifer, can be inferred from structural analysis of geophysical data and from regional fault patterns; (2) the proposed faults account for the anomalous northeastward elongation of the potentiometric surface of the Upper Floridan aquifer; (3) the faults breach the nearly impermeable units that confine the Upper Floridan aquifer from below, allowing substantial quantities of water to leak vertically upward; as a result, aquifer transmissivity need not be excessively large (as previously reported) to sustain the heavy, long-term pumpage at Brunswick without developing a steep cone of depression in the potentiometric surface; (4) increased fracturing at the intersection of the faults enhances the development of conduits that allow the upward migration of high-chloride water in response to pumping from the Upper Floridan aquifer; and (5) the anomalous movement of the chloride plume is almost entirely controlled by the faults. (Author's abstract)
W91-00877

EVAPORATION FROM DAMPLAND VEGETATION ON A GROUNDWATER MOUND.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2D.
W91-00879

WATER BANKING THROUGH ARTIFICIAL RECHARGE, LAS VEGAS VALLEY, CLARK COUNTY, NEVADA.
Las Vegas Valley Water District, NV.
For primary bibliographic entry see Field 4B.
W91-00880

MOVEMENT AND FATE OF ATRAZINE AND BROMIDE IN CENTRAL KANSAS CROPLANDS.
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5B.
W91-00882

THEORY AND APPLICATION OF AN APPROXIMATE MODEL OF SALTWATER UPCONING IN AQUIFERS.
Kansas State Geological Survey, Lawrence.
C. McElwee, and M. Kemblowski.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 139-163, July 1990. 8 fig, 25 ref. U. S. Geologic Survey Grant No. 14-08-0001-G1066.

Descriptors: *Aquifers, *Geohydrology, *Groundwater chemistry, *Groundwater movement, *Saline water intrusion, *Upconing, Boundary layers, Data analysis, Flow models, Groundwater management, Groundwater pollution, Groundwater quality, Kansas, Mathematical models, Saline water, Smoky Hill River.

Motion and mixing of salt water and fresh water are vitally important for water-resource development throughout the world. An approximate model of saltwater upconing in aquifers is developed, which results in three non-linear coupled equations for the freshwater zone, the saltwater zone, and the transition zone. The description of the transition zone uses the concept of a boundary layer. This model invokes some assumptions to give a reasonably tractable model, considerably better than the sharp interface approximation but considerably simpler than a fully three-dimensional model with variable density. The validity of the Dupuit-Forchheimer approximation of horizontal flow in each layer is assumed. Vertical hydrodynamic dispersion into the base of the transition zone is assumed; the concentration of the saltwater zone is assumed constant. Solute in the transition zone is assumed to be moved by advection only. Velocity and concentration are allowed to vary vertically in the transition zone by using shape functions. Several numerical techniques can be used to solve the model equations, and simple analytical solutions can be useful in validating the numerical solution procedures. The approximate model is applied to the Smoky Hill River valley in central Kansas. This model can reproduce earlier sharp interface results as well as evaluate the importance of hydrodynamic dispersion for feeding salt water to the river. Using a wide range of dispersivity values showed that unstable upconing always occurs. Therefore, in this case, hydrodynamic dispersion is not the only mechanism feeding salt water to the river. Calculations imply that unstable upconing and hydrodynamic dispersion could be equally important in transporting salt water. The current model could be useful in situations involving dense saltwater layers. (Author's abstract)
W91-00883

MOTION OF COASTAL GROUNDWATER IN RESPONSE TO THE TIDE.
Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
K. Inouchi, Y. Kishi, and T. Kakinuma.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 165-191, July 1990. 19 fig, 1 tab, 31 ref, append.

Descriptors: *Aquifers, *Coastal aquifers, *Groundwater movement, *Japan, *Saline water intrusion, *Tidal effects, Data analysis, Flow models, Geohydrology, Groundwater quality, Mathematical models, Transition zone.

Problems of seawater intrusion into confined coastal aquifers under the influence of the tide were analyzed using two different models; the freshwater-saltwater interface model and the dispersion model. The freshwater-saltwater interface model, which describes the motion of the groundwater level and the freshwater-saltwater interface in response to the tide, was applied to the confined coastal aquifers in the estuary of the Naka River and Yura district of Gogo Island in Japan. The position of the outlet of the confined groundwater into the sea and also the degree of spreading of the aquifer's thickness, which is assumed to vary exponentially with horizontal distance, were estimated. From the non-dimensional analysis based on the dispersion model, it was found that salt water intrudes furthest inland at the time at which the sea level reaches the mean sea level in the ebb tide stage, consistent with the result obtained by the freshwater-saltwater interface model, and the transition zone from fresh water to salt water becomes widest at that time. (Author's abstract)
W91-00884

RELATIVE PERFORMANCE OF A SOIL MOISTURE ACCOUNTING MODEL IN ESTIMATING RETURN FLOW.
Roorkee Univ. (India). School of Hydrology.
For primary bibliographic entry see Field 2G.
W91-00887

HYDROLOGY OF THE KARST AQUIFER AT THE EXPERIMENTAL SITE OF GUILIN IN SOUTHERN CHINA.
Institute of Karst Geology, Guilin (China).
Y. Daoxian, C. Drogue, D. Aide, L. Wenke, and C. Wutian.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 285-296, July 1990. 8 fig, 2 tab, 17 ref.

Descriptors: *China, *Geohydrology, *Karst hydrology, Boreholes, Geological surveys, Groundwater budget, Groundwater movement, Intermittent springs, Oxygen isotopes, Perennial springs, Storm seepage, Structural geology.

The experimental site of Guilin is located near the village of Yaji at the border of the Lijang Plain (Province of Guangxi, southern China). Within upper Devonian limestones and dolomitic limestones, a karst has developed in accordance with intense fracturing resulting from Mesozoic and Tertiary tectonic episodes. Its morphology is characterized by two major types of karst: a cone karst (peak cluster area) bounded by the Lijang Plain which comprises a tower or mogote karst (peak forest area). Groundwater discharges from a perennial spring (discharge up to 7 cubic meters/s) and three intermittent springs (discharge less than 5 cubic meters/s). Some observation boreholes have been drilled on the peak cluster area dolines and on the Lijang Plain in front of the spring. Tracing experiments in the dolines showed that the dolines are connected with the springs. The apparent flow velocity ranges between 4 and 180 m/h. Analyses of storm responses of the perennial spring and the variability in time of O18 concentration, pointed out the important role played by the flows occurring in the subcutaneous zone of the peak cluster area. (Author's abstract)
W91-00891

GROUNDWATER RESPONSE TO REFORESTATION IN THE DARLING RANGE OF WESTERN AUSTRALIA.
Water Authority of Western Australia, Perth.
R. W. Bell, N. J. Schofield, I. C. Loh, and M. A. Bari.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 297-317, July 1990. 9 fig, 2 tab, 26 ref.

Descriptors: *Australia, *Forest watersheds, *Groundwater level, *Groundwater management, *Reforestation, *Soil-water-plant relationships, *Surface-groundwater relations, *Vegetation effects, *Water table fluctuations, Forest hydrology, Rainfall, Salinity, Stream degradation, Water table rise.

Replacement of deep-rooted perennial vegetation with annual crops and pastures has led to rising groundwater tables and transport of previously stored salts to streams in south-west Western Australia. Trials to determine the potential of various reforestation strategies to reverse this process by lowering the groundwater table were commenced in 1976. Results were obtained from six experimental sites for the period 1979-1986. Despite the mean annual rainfall of the experimental period being 10% below the 1926-1986 mean, groundwater levels under pasture rose by up to 1.2 m. The change in groundwater levels beneath reforestation ranged from a 0.6 m increase to a 3 m decrease relative to the ground surface. Groundwater levels under reforestation in all cases decreased relative to groundwater levels under pasture. The magnitude of this reduction was shown to increase with the proportion of cleared area reforested and with the crown cover of the reforestation. The salinity of the water table decreased by 12% under reforestation and by 32% under pasture over the period 1979-1986. (Author's abstract)
W91-00892

USING RN222 TO EXAMINE GROUNDWATER/SURFACE DISCHARGE INTERACTION IN THE RIO GRANDE DE MANATI, PUERTO RICO.
Florida Univ., Gainesville. Dept. of Geology.
K. K. Ellins, A. Roman-Mas, and R. Lee.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/

4, p 319-341, July 1990. 10 fig, 6 tab, 37 ref.

Descriptors: *Environmental tracers, *Groundwater movement, *Karst, *Karst hydrology, *Puerto Rico, *Radon radioisotopes, *Surface-groundwater relations, *Tracers, Data acquisition, Geohydrology, Geophysical surveys, Groundwater budget, Streamflow.

Rn222 was used in the karst drainage basin of the Rio Grande de Manati in Puerto Rico to study groundwater/surface flow relationships. Locations of groundwater influx along two sections of the Rio Grande de Manati were identified. The Rn222 measurements were used together with stream discharge data in a mass balance equation to quantify the groundwater inputs. The investigation established that both of the sections of the Rio Manati surveyed not only gained groundwater, but lost surface flow. It was calculated that the river gained about 1.2 cubic meters/s and lost 0.5 cubic meters/s to the aquifer between Ciales and United States Geological Survey gauging station 5. Between United States Geological Survey gauging stations 6 and 7, groundwater influx and stream flow loss occurred simultaneously with groundwater inputs equalling surface discharge losses of 4 cubic meters/s. The study successfully demonstrated the innovative application of Rn222 as a geochemical tracer in examining groundwater/surface flow relationships in a karst system. (Author's abstract)
W91-00893

GEOSTATISTICAL METHODS FOR DETECTION OF OUTLIERS IN GROUNDWATER QUALITY SPATIAL FIELDS.
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft.
A. Bardossy, and Z. W. Kundzewicz.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 343-359, July 1990. 2 fig, 8 tab, 17 ref.

Descriptors: *Groundwater chemistry, *Groundwater quality, *Statistical analysis, Chlorides, Data analysis, Geohydrology, Groundwater data, Groundwater pollution, Hardness.

Detection of discordant groundwater quality observations is of primary importance. Because of the large amount of data to be analyzed, methods of plausibility analysis need to be simple and not too time-consuming. Two geostatistical methods were studied, which allow the identification of outlying data points based on the pattern present in the remaining data. The two methods used, point kriging and the intrinsic random functions of order k method (IRF-k), differ in severity of assumptions. The advantage of point kriging is its simplicity, and the disadvantage is the severity of the assumptions. The method is based on assumptions of either stationarity or intrinsic (weaker) stationarity. Both assumptions are restrictive in comparison the IRF-k method, which can accomodate polynomial trend (drifts) of the order k. However, in contrast to point kriging, the IRF-k method offers the welcome possibility of fully automated detection of outliers, which is particularly attractive in operational detection of outliers. Both approaches were tested on concentration of chloride and on total hardness in groundwater and performed satisfactorily. They lend themselves well also to operational applications. The use of the simple point kriging procedure is recommended for outlier detection (also for operational use) in the case of no significant drift, and the use of the IRF-k method otherwise. (Hoskin-PTT)
W91-00894

CLASSIFICATION OF SHALLOW GROUNDWATER TYPES IN A DUTCH COVERSAND LANDSCAPE.
Amsterdam Univ. (Netherlands). Landscape and Environmental Research Group.
For primary bibliographic entry see Field 2K.
W91-00895

SIMULATION OF NITRATE NITROGEN BREAKTHROUGH CURVES STEMMING FROM LEACHING OF AMMONIUM NITRATE THROUGH SOIL.
Orissa Univ. of Agriculture and Technology, Bhubaneswar (India).
For primary bibliographic entry see Field 5B.
W91-00896

MODULAR MODEL FOR SIMULATING CONTINUOUS OR EVENT RUNOFF.
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
For primary bibliographic entry see Field 2E.
W91-00970

CONCEPTUAL MODEL SIMULATING THE HYDROLOGICAL PROCESSES ON A DRAINAGE BASIN IN A PLAIN AREA.
Hohai Univ., Nanjing (China). Dept. of Hydrology.
For primary bibliographic entry see Field 2E.
W91-00981

EFFECTS OF RECHARGE SYSTEMS ON HYDROLOGICAL INFORMATION TRANSFER ALONG RIVERS.
9 Eylul Univ., Izmir (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00984

2G. Water In Soils

MODELING INFILTRATION IN HYSTERETIC SOILS.
Kentucky Univ., Lexington. Dept. of Civil Engineering.
S. E. Serrano.
Advances in Water Resources AWREDI, Vol. 13, No. 1, p 12-23, March 1990. 12 fig, 43 ref.

Descriptors: *Hysteresis, *Infiltration, *Mathematical models, *Model studies, *Rainfall infiltration, *Stochastic models, *Surface-groundwater relations, *Unsaturated flow, Data interpretation, Differential equations, Diffusivity, Groundwater movement, Mathematical studies, Percolation, Soil water.

Existing vertical infiltration models either assume a constant infiltration rate at the soil surface and a unique set of soil-water functional relationships (hysteresis is neglected), or use empirical expressions which disregard physical laws. A method for analyzing vertical infiltration in hysteretic soils subject to the random variations of point rainfall in watersheds, and a procedure for solving the resulting stochastic partial differential equation, is presented. The effect of the time random variability of point rainfall produces a water content process in the upper soil layer which can be modeled as a shot noise process. The hysteretic loops resulting from the natural wetting and drying cycles generate a correlated random soil-water diffusivity process. The modeling problem reduces to the solution of the infiltration equation subject to a shot noise boundary condition and a colored noise soil-water diffusivity. A new semi-group solution of this evolution equation is obtained and expressions for sample functions, the mean and the variance of the water content in space and time, are derived. A computational procedure for each of the components of the stochastic solution is presented, and suggestions for the reduction of the predicted variance are given. It is hoped that the present methodology will provide the modeler with a better tool to model infiltration in natural soils subject to the uncertainties associated with the rainfall regime and the hysteresis in the soil, and to encourage the use of physically based models for infiltration rather than empirical equations. (Author's abstract)
W91-00118

MOISTURE VARIATION STUDY BY NEUTRON-NEUTRON LOGGING.
Central Ground Water Board, Ahmedabad (India).
For primary bibliographic entry see Field 7C.
W91-00255

STUDY OF SOIL MOISTURE MOVEMENT IN THE VADOSE ZONE USING NEUTRON PROBE.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 7B.
W91-00256

SOIL MOISTURE STUDIES IN SOILS OF DELHI TERRITORY USING THE RESISTIVITY METER.
Indian Agricultural Research Inst., New Delhi. Nuclear Research Lab.
H. Chandrasekharan, B. R. Yadav, S. K. Tyagi, and P. B. S. Sarma.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 385-393, 4 fig, 2 tab, 10 ref.

Descriptors: *Data acquisition, *Delhi, *Geophysical surveys, *India, *Resistivity surveys, *Soil water, Conductivity, Electrical properties, Measuring instruments, Soil properties, Soil types.

The utility of a resistivity meter for the study of soil moisture in 21 villages of the Nangoli and Najafgarh blocks, and the Indian Agricultural Research Institute farm of the Delhi region, are presented in light of other soil water properties. Investigations reveal that for a given soil type, and for a given range of electrical conductivity of a soil saturation extract, the bulk soil electrical conductivities and the soil moisture contents have a linear relationship. An investigation of differing soil types may yield a better understanding of the potential of resistivity meters in determining soil moisture content. A correlation can be drawn between bulk soil electrical conductivity (determined by a resistivity meter), and the soil moisture content (Vol.vol%). (See also W91-00215) (Lantz-PTT)
W91-00258

FUNCTIONAL RELATION FOR CAPILLARY SUCTION VS. MOISTURE CONTENT.
Roorkee Univ. (India). School of Hydrology.
For primary bibliographic entry see Field 7C.
W91-00260

INVESTIGATING SEPTIC DISPOSAL SITES USING A VELOCITY PERMEAMETER.
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W91-00394

USE OF SATELLITE MICROWAVE RADIOMETERS FOR LARGE-SCALE HYDROLOGY.
Innsbruck Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
For primary bibliographic entry see Field 7B.
W91-00457

GENERAL MASS-CONSERVATIVE NUMERICAL SOLUTION FOR THE UNSATURATED FLOW EQUATION.
Princeton Univ., NJ. Water Resources Program.
M. A. Celia, E. T. Bouloutas, and R. L. Zarba.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1483-1496, July 1990. 7 fig, 20 ref. Nuclear Regulatory Commission Contract NRC-04-88-074, National Science Foundation Grant 8657419-CES, U.S. Environmental Protection Agency Agreement CR-814946.

Descriptors: *Flow equations, *Flow models, *Fluid flow, *Mathematical models, *Model studies, *Soil water, *Unsaturated flow, Aeration zone, Differential equations, Flow prediction, Infiltration, Mass balance, Mathematical analysis, Numerical analysis.

Prediction of fluid movement in unsaturated soils is an important problem in many branches of science and engineering, including soil science, agricultural

engineering, environmental engineering, and groundwater hydrology. In virtually all studies of the unsaturated zone, the fluid motion is assumed to obey the classical Richards equation. Numerical approximations based on different forms of the governing partial differential equation can lead to significantly different results for unsaturated flow problems. Numerical solution based on the standard h-based form of Richards equation generally yield poor results, characterized by large mass balance errors and erroneous estimates of infiltration depth. Conversely, numerical solutions based on the mixed form of Richards equation can be shown to possess the conservative property, so that mass is perfectly conserved. This leads to significant improvement in numerical solution performance, while requiring no additional computational effort. However, use of the mass-conservative method does not guarantee good solutions. Accurate solution of the unsaturated flow equation also requires use of a diagonal time (or mass) matrix. Only when diagonal time matrices are used can the solution be shown to obey a maximum principle, which guarantees smooth, nonoscillatory infiltration profiles. This highlights the fact that proper treatment of the time derivative is critical in the numerical solution of unsaturated flow. (MacKeen-PTT)
W91-00595

ZERO-CURTAIN EFFECT: HEAT AND MASS TRANSFER ACROSS AN ISOTHERMAL REGION IN FREEZING SOIL.
Michigan Univ., Ann Arbor. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2C.
W91-00597

NITROUS OXIDE DISSOLVED IN SOIL SOLUTION: AN INSIGNIFICANT PATHWAY OF NITROGEN LOSS FROM A SOUTHEASTERN HARDWOOD FOREST.
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
E. A. Davidson, and W. T. Swank.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1687-1690, July 1990. 2 tab, 15 ref. NSF Grants BSR-83-06181 and BSR-8514328.

Descriptors: *Denitrification, *Forest soils, *Nitrogen cycle, *Nitrous oxide, *Soil solution, Forest ecosystems, Forest watersheds, Nitrogen removal, North Carolina, Riparian zone, Seasonal variation, Solubility.

Understanding the processes of nitrous oxide production and diffusion in soil is complicated by the solubility of nitrous oxide in soil solution. Nitrous oxide is soluble and can accumulate in soil solution when gaseous diffusion is restricted. The importance of N losses via degassing of nitrous oxide from groundwater entering surface streams is unknown. Measurements of nitrous oxide in soil solution at an 8.9 ha watershed at the USDA Forest Service Coweeta Hydrologic Laboratory, North Carolina, revealed patterns of seasonal and spatial variation that were consistent with ecosystem regulation of denitrification. The highest concentrations were observed in the riparian zone in May, when soil nitrate, temperature, and moisture were conducive for denitrification. At each of the other sample dates and sites, at least one of these factors appeared to prevent significant nitrous oxide accumulation in soil solution. Extrapolation of the highest observed nitrous oxide concentrations to an annual basis corresponded to a loss of only 56 g N/ha/yr. Denitrification in the riparian zone may be an important fate of N in this hardwood forest, but nitrous oxide in soil solution does not appear to be a significant pathway of N loss. This site might be expected to produce nitrous oxide at higher rates than most hardwood forests, but extrapolation of the highest calculated losses from soil solution over the global area occupied by hardwood forest indicates that this source of nitrous oxide is insignificant for global atmospheric budgets. (Author's abstract)
W91-00613

PRESERVATION OF PLANT POLYMERS IN PEAT AND LIBERATION OF THEIR MONOMERS DUE TO ARTIFICIAL DRAINAGE.
Oulu Univ. (Finland). Dept. of Biochemistry.
For primary bibliographic entry see Field 2H.
W91-00643

PERIODIC MOISTURE FLUCTUATION AS A FACTOR AFFECTING MIRE VEGETATION.
Oulu Univ. (Finland). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W91-00644

TRANSFORMATION AND TRANSPORT OF AMMONIUM NITROGEN IN A FLOODED ORGANIC SOIL.
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
For primary bibliographic entry see Field 5B.
W91-00716

SPECTROSCOPIC INVESTIGATIONS OF PEAT-WATER INTERACTIONS: AN ESR, FT-IR, AND NMR STUDY.
Umea Univ. (Sweden). Dept. of Physical Chemistry.
For primary bibliographic entry see Field 2H.
W91-00789

INFILTRATION UNDER PONDED CONDITIONS: 3. A PREDICTIVE EQUATION BASED ON PHYSICAL PARAMETERS.
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
R. Havercamp, J. Y. Parlange, J. L. Starr, G. Schmitz, and C. Fuentes.
Soil Science SOSCAK, Vol. 149, No. 5, p 292-300, May 1990. 6 fig, 23 ref.

Descriptors: *Infiltration, *Infiltration capacity, *Mathematical models, *Ponding, *Soil water, Clays, Diffusivity, Sand, Soil types.

A new filtration equation was derived that takes into account the possibility of an infinite diffusivity near saturation. Using the example of two soils (clay and coarse sand), the new filtration equation has a sound physical basis. In particular, all parameters used are true soil properties that are constant with time and independent of the water depth imposed as a boundary condition. Different assumptions used for the development of the infiltration equation had to be verified: (1) the validity of the shape identity hypothesis, and (2) the validity of considering the soil moisture pressure value as a soil parameter constant in time and independent of surface boundary conditions. This permits the use of the infiltration model for prediction purposes. Compared with analytical, numerical, and experimental results, the equation shows a great precision (sigma squared $<$ .00510 square cm) at all times. The present law introduces a significant improvement over the law obtained previously dealing with ponded infiltration by introducing the physical effect of an infinite diffusivity at saturation. (Author's abstract)
W91-00790

WATER QUALITY AND PAM INTERACTIONS IN REDUCING SURFACE SEALING.
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
For primary bibliographic entry see Field 4D.
W91-00791

DEPLETION AND RECHARGE OF SOIL WATER IN TWO STANDS OF NORWAY SPRUCE (PICEA ABIES (L.) KARST).
Sveriges Lantbruksuniversitet, Umea. Dept. of Forest Site Research.
L. G. Norden.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 197-213, July/September 1990. 8 fig, 5 tab, 37 ref.

Descriptors: *Correlation analysis, *Forest hydrology, *Forest soils, *Recharge, *Soil water, *Spruce trees, *Statistical methods, *Water depletion, Drought, Gypsum, Spearman rank correlation, Soil water table, Statistical analysis, Sweden.

Depletion and recharge dynamics of soil water were studied at two forest sites in Northern and Southern Sweden during three growing seasons. At each site having a stand of Norway spruce (Picea abies (L.) Karst), soil water potential was measured with 90 gypsum blocks in 30 profiles at depths of 6, 20, and 50 cm from the soil surface. The size of the rectangular plots was 250 square cm. The large variation in soil water potential during desiccation periods extended throughout the measuring range of the gypsum blocks. The soil water potentials, at different times and depths, were log-normally distributed during only parts of the desiccation periods. Due to the large variation and skewed distribution of soil water potentials the nonparametric Spearman rank correlation statistic was used to analyze the pattern of desiccation. In the beginning of a dry period, the topsoil was more efficiently desiccated than the subsoil at both sites. This difference lasted throughout all droughts at the southern site and was explained by a higher root density in the topsoil. At the northern site, however, there was no difference in the degree of desiccation at different soil depths during an extended desiccation period. There was a vertical relationship in soil water desiccation in which an accentuated water depletion at the 6 cm soil depth was followed by a similar strong depletion 14 cm lower in the same observation profile. Strongly desiccated observation profiles were not necessarily situated close to each other but seemed randomly spread over the site. There was no relationship between extracted water at any of the three soil depths in the different observation profiles and proximity to trees or tree size. (Author's abstract)
W91-00860

SEASONAL SOIL WATER DYNAMICS IN THE JARRAH FOREST, WESTERN AUSTRALIA. I: RESULTS FROM HILLSLOPE TRANSECT WITH COARSE-TEXTURED SOIL PROFILES.
Water Authority of Western Australia, Perth.
J. K. Ruprecht, and N. J. Schofield.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 241-258, July/September 1990. 10 fig, 2 tab, 28 ref.

Descriptors: *Australia, *Eucalyptus trees, *Geohydrology, *Infiltration, *Slopes, *Soil water, *Soil water potential, *Surface-groundwater relations, Matric potential, Moisture meters, Recharge, Seasonal variation, Soil profiles, Tensiometers.

Seasonal soil water dynamics were measured on a hillslope transect in the jarrah forest of southwest Western Australia over the period 1984-86 using mercury manometer tensiometers, gypsum blocks, and a neutron moisture meter. The soil water potential gradients indicated downward vertical drainage flux through winter and spring. There was generally a change to an upward flux in early summer which was sustained through to autumn. A shallower ephemeral saturation zone was identified in and above a duricrust layer, lasting up to three days after heavy, late winter rainfall. The annual maximum to minimum unsaturated soil water storage on the hillslope was approximately 400 mm to 6 m depth and 480 mm to 15 m depth. This did not change significantly in years of substantially different winter rainfall. The magnitude of seasonal soil water storage was similar to other forested areas with deep soil profiles. The depth of observable infiltration was dependent on annual rainfall. This was consistent with the observation that groundwater levels responded to rainfall over the whole hillslope in wet years but only responded on the lower slopes in dry years. The average summer drying rate of the soil profile to 6 m of 3.5 mm/day was within the range of values reported for forests elsewhere. In late summer, following an extended drought period, the drying rate decreased downslope but increased midslope. (See also W91-00864) (Author's abstract)
W91-00863

SEASONAL SOIL WATER DYNAMICS IN THE JARRAH FOREST, WESTERN AUSTRALIA. II:

RESULTS FROM A SITE WITH FINE-TEXTURED SOIL PROFILES.
Water Authority of Western Australia, Perth.
J. K. Ruprecht, and N. J. Schofield.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 259-267, July/September 1990. 7 fig, 9 ref.

Descriptors: *Australia, *Eucalyptus trees, *Geohydrology, *Infiltration, *Slopes, *Soil water, *Soil water potential, *Surface-groundwater relations, Matric potential, Moisture meters, Recharge, Seasonal variation, Soil profiles, Tensiometers.

Seasonal soil water dynamics were measured at a fine-textured, upslope site within the jarrah forest of southwest Western Australia and compared to the results from a coarse-textured hillslope transect. Gravity drainage dominated during winter and early spring. This reversed in early summer and an upward potential was observed to 7 m depth. A shallow ephemeral saturation zone was observed above a clay pan at 1.5 m depth. This saturation zone persisted through late winter and early spring, contrasting with the short-lived saturation in the duricrust on the hillslope transect. The annual maximum to minimum unsaturated soil water storage was about 530 mm, 50 mm greater than the hillslope transect and higher than most values reported elsewhere in Australia. Significant soil water content changes following winter rain were generally restricted to 6 m but at one site occurred to 9 m. These depths were significantly less than the coarser-textured hillslope transect. Soil water drying rates averaged 5 mm/day during extended dry periods compared to 3.5 mm/day on the hillslope transect. The drying rate occurred uniformly through the profile until late summer when a significant decrease in the upper 3 m was observed. (See also W91-00863) (Author's abstract)
W91-00864

MOVEMENT AND FATE OF ATRAZINE AND BROMIDE IN CENTRAL KANSAS CROPLANDS.
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5B.
W91-00882

RELATIVE PERFORMANCE OF A SOIL MOISTURE ACCOUNTING MODEL IN ESTIMATING RETURN FLOW.
Roorkee Univ. (India). School of Hydrology.
K. M. M. Mohan Rao, D. Kashyai, and S. Chandra.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 231-241, July 1990. 3 fig, 3 tab, 13 ref.

Descriptors: *Flow models, *Groundwater movement, *Groundwater recharge, *Irrigation water, *Model studies, *Return flow, *Soil moisture, Natural recharge, Soil moisture retention, Soil types.

The current practice of estimating return flow (also know as groundwater recharge) from irrigation and rainfall is mostly based on soil moisture accounting (SMA) models and involves many restrictive assumptions. Prominent among them is the existence of a threshold moisture content termed 'field capacity', which must be quantified as a flow parameter to be compatible with its hydraulic implication in the SMA models. This study developed: (1) a method for quantifying field capacity as a flow parameter; and, (2) an assessment of a proposed SMA model for estimation of return flow, in comparison with an earlier distributed model based on a finite difference solution of the Richards' equation, for studying the possibility of replacement of the more elaborate distributed model by the easy to adopt SMA model. Distributed models (based on solution of the Richards' equation) are free from many of the restrictive assumptions associated with the SMA models, particularly that of field capacity. Thus, comparison of the return flow estimates of both these models, would show the impact of the restrictive assumptions in the SMA models. Use of an identical database showed reasonable agreement between the seasonal totals of return flow as predicted by both models. However, the daily rates differ considerably. These observations show the effects of not accounting for the time lag on occurrence, underestimation and overestimation of the return flow by the SMA model. Further, in general, the performance of the SMA model is more acceptable (in view of the objectives of the work) in the case of the loam soil (coarse soil), perhaps because the quantification of field capacity as a flow parameter by the proposed method is more suitable for coarse soils. (Hoskin-PTT)
W91-00887

NOTE ON THE ANALYSIS OF MOISTURE-DEPTH CURVES OBTAINED BY THE HOT-AIR METHOD FOR THE DETERMINATION OF SOIL MOISTURE DIFFUSIVITY.
Botswana Univ., Gaborone. Dept. of Geology.
A. Gieske, and J. J. De Vries.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 261-268, July 1990. 4 fig, 2 tab, 10 ref.

Descriptors: *Diffusivity, *Laboratory methods, *Soil moisture retention, *Soil water, Data analysis, Hot air method.

Diffusivities of undisturbed soil samples can be determined with the so-called hot-air method. Undisturbed soil cores collected in the field with hydraulic equipment are carefully equilibrated in the laboratory at suction levels between 1 and 10 kPa (pF1 and pF2 respectively). Hot air is then blown against one end of the core for a short period of time, causing the sample to dry out quickly from that end. By cutting the core into thin slices and determining the moisture content of each slice, a moisture distribution curve can be established from which the diffusivity as a function of moisture can be calculated. Several graphical and numerical methods exist for the analysis of the moisture vs. depth curves obtained with this method. Moreover, an implicit finite difference approach to the problem suggests that near the drying surface of the soil sample, diffusivity values are higher than under natural circumstances as a result of the treatment with hot air. The parameters of the diffusivity model depend sensitively on the data and therefore the numerical processing of the moisture vs. depth curves must be handled with caution, bearing in mind the various possible disturbances. (Hoskin-PTT)
W91-00889

SIMULATION OF NITRATE NITROGEN BREAKTHROUGH CURVES STEMMING FROM LEACHING OF AMMONIUM NITRATE THROUGH SOIL.
Orissa Univ. of Agriculture and Technology, Bhubaneswar (India).
For primary bibliographic entry see Field 5B.
W91-00896

METHOD TO EXTRACT SOIL WATER FOR STABLE ISOTOPE ANALYSIS.
Geological Survey, Reston, VA.
K. Revesz, and P. H. Woods.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 397-406, July 1990. 3 fig, 5 tab, 20 ref.

Descriptors: *Deuterium, *Laboratory methods, *Oxygen isotopes, *Sampling, *Soil water, *Water analysis, Chemical analysis, Distillation, Mass spectrometry, Temperature effects, Toluene.

A method has been developed to extract soil water for determination of deuterium (D) and O18 content. The principle of this method is based on the observation that water and toluene form an azeotropic mixture at 84.1 degrees C but are completely immiscible at ambient temperature. In a specially designed distillation apparatus, the soil water is distilled at 84.1 degrees with toluene and is separated quantitatively in the collecting funnel at ambient temperature. Traces of toluene are removed and the sample can be analyzed by mass spectrometry. Kerosene may be substituted for toluene. The accuracy of this technique is +/-2 and +/-0.2%, respectively, for delta D and delta O18. Reduced accuracy is obtained at low water contents. (Author's abstract)
W91-00898

EVAPORATION FROM SOIL SURFACE IN PRESENCE OF SHALLOW WATER TABLES.
Mosul Univ. (Iraq). Dept. of Irrigation and Drainage.
For primary bibliographic entry see Field 2D.
W91-00996

USING GIS TO ASSESS SPATIAL VARIABILITY OF SCS CURVE NUMBER AT THE BASIN SCALE.
Politecnico di Milano (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 2E.
W91-01004

2H. Lakes

EMPIRICAL MODELS FOR PREDICTING WATER QUALITY, AS APPLIED TO DATA ON LAKES OF POLAND.
Polish Academy of Sciences, Warsaw. Zaklad Paleobiologii.
J. Uchmanski, and W. Szeligiewicz.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 285-316, 1989. 7 fig, 7 tab, 33 ref, 3 append.

Descriptors: *Chlorophyll a, *Limnology, *Mathematical models, *Phosphorus, *Secchi disks, *Seston, *Water quality, Hypolimnion, Lakes, Oxygen, Poland.

Data were collected on the concentration of total P, visibility of Secchi disks, concentration of chlorophyll-a, and concentration of seston in several lakes in northern Poland. These data were used to develope a predictive model of P concentrations in lakes. After testing several versions, the model with a variable retention coefficient was selected. Regression equations were found describing relationships between the visibility of Secchi disk and the P concentration, the dry chlorophyll-a concentration and the P concentrations, and the dry seston concentration and the visibility of Secchi disk. Predictive equations were also developed for oxygen concentrations in the hypolimnion. (Author's abstract)
W91-00001

NUMERICAL MODEL OF PHOSPHORUS EXCHANGE BETWEEN THE SEDIMENTS AND THE NEAR-BOTTOM WATER IN A LAKE.
Warsaw Univ. (Poland). Lab. of Medical Physics.
P. Mitraszewski, and J. Uchmanski.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 317-346, 1988. 19 fig, 5 tab, 17 ref.

Descriptors: *Bottom sediments, *Cycling nutrients, *Limnology, *Phosphorus, *Poland, Bottom water, Lake Glebokie, Lake Inulec, Lakes, Mathematical models, Mathematical studies, Midges, Oligochaetes.

A model is presented which describes P exchange between the sediments and the near-bottom water in a lake. The effect of bottom animals (Chironomidae and Tubificidae) on this process, through their respiratory activity, was considered. Two versions of the model were considered, for anaerobic and for aerobic conditions, when a highly oxygenated sediment layer at the interface with the near-bottom water prevents the diffusion of phosphorus. The model was fitted with results from experiments with bottom-sediment cores taken from Lake Glebokie and Lake Inulec, Poland. The model was found to be more sensitive to changes of all the parameters under anaerobic than under aerobic conditions. Variation in temperature and oxygen concentration causes greater changes than is naturally characterized by small temperature oscillations, and a low oxygen concentration near the bottom. If benthic organisms are eliminated from the model, phosphorus concentration in the near-bottom water drops by about 30% in the case of Chironomidae, and by about 10% in the case of Tubificidae. Results from sensitivity analysis of the model indicate that the role of Chironomidae in phosphorus concentration is more important than that of Tubificidae. (Sand-PTT)
W91-00002

SIMULATION MODEL OF PHOSPHORUS CYCLING IN THE EPILIMNION OF A EUTROPHIC LAKE.
Polish Academy of Sciences, Warsaw. Zaklad Paleobiologii.
J. Uchmanski.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 347-386, 1988. 29 fig, 5 tab, 20 ref.

Descriptors: *Cycling nutrients, *Epilimnion, *Limnology, *Model studies, *Phosphorus, *Poland, *Simulation analysis, Aquatic bacteria, Detritus, Lake Glebokie, Microbiological studies, Phytoplankton, Water temperature, Zooplankton.

Time-related changes in the epilimnion of Lake Glebokie, Poland are described in a model using six variables: concentration of dissolved orthophosphate phosphorus, phytoplankton, bacteria, detritus, non-predatory zooplankton, and predatory zooplankton in the epilimnion of Lake Glebokie. The stability of the model was analyzed, and it was found that the variables showed damped oscillations around equilibrium points. Results of numerical experiments are presented, simulating a cessation of fish farming in the lake, changes in the water level, timing of P inflow to the epilimnion from deeper layers of the lake, and changes in temperature and light conditions. Results show that the inflow of P from deeper layers largely influences the values of the model variables. (Author's abstract)
W91-00003

METHODS FOR IMPROVING THE EFFICIENCY OF CALIBRATION OF A MODEL OF PHOSPHORUS CYCLING IN A LAKE ECOSYSTEM.
Politechnika Warszawska (Poland). Inst. of Environmental Engineering.
M. Loga.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 387-406, 1988. 8 fig, 4 tab, 12 ref.

Descriptors: *Cycling nutrients, *Limnology, *Mathematical models, *Model studies, *Phosphorus, *Phytoplankton, *Poland, Aquatic bacteria, Detritus, Lake Glebokie, Mathematical studies, Microbiological studies, Sensitivity analysis, Simulation analysis, Zooplankton.

As has been indicated by practice, the traditional trial and error method is not an efficient tool for estimating the parameters of ecological models. The degree of complication of a typical ecological model also makes it impossible to use currently available formal algorithms. Two techniques are presented which can increase the chance to obtain parameter values approximate to the correct ones through a better control of the process of estimation: the step by step merging subsequent method (SMSSE) and sensitivity analysis-aided estimation. The former method reduces the number of parameters estimated simultaneously, by eliminating some of the state equations. If necessary, evaluations of these equations are replaced in other equations with their approximations (e.g., Fourier series) obtained from measurement data. Though mentioned in the literature, the use of sensitivity analysis in the course of the estimation process is an underestimated improvement of the trial and error method. If applied during the calibration of a model, and not after its completion, sensitivity analysis makes it possible to better understand the structure of a model, thereby improving the process of estimation. Both methods can improve the equations of a model in situations where the parameters that are being estimated assume values differing from so-called reasonable values (e.g. values quoted in the literature, with ecological interpretations or measured data), or where repeated efforts fail to bring a satisfactory consistency to simulation results with measured data. This latter situation occurred in the study of a model of phosphorus cycling in the epilimnion of Lake Glebokie. Figures presented in the paper indicate a poor consistency of the simulation results with measured data. A model with a variable form of the equation defining the dynamics of bacteria gives a far better consistency of simulation results with measurement data. (Sand-PTT)
W91-00004

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM. XIX. SUSPENDED-MATTER SEDIMENTATION.
Polish Academy of Sciences, Krakow. Zaklad Ochrony Przyrody i Zasobow Naturalnych.
A. Lajczak.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 407-424, 1988. 9 fig, 1 tab, 26 ref.

Descriptors: *Goczalkowice Reservoir, *Poland, *Reservoir sediments, *Reservoir silting, *Sedimentation, *Suspended sediments, Bottom sediments, Erosion, Reservoir operation, Seasonal variation, Sediment erosion.

Long-term and seasonal variation in the silting rate of the Goczalkowice Reservoir, Poland, has been described on the basis of suspended material loads, and input and output, calculated during the first 25 years of operation. The course of the silting process in this large, shallow foreland reservoir, with intensive waves, differs significantly from that seen in other shallow water bodies in southern Poland. The first 12-year period of permanent retention of suspended material was followed by increasingly intensive erosion of the bottom sediments of the reservoir, and their output outside the dam. After the reservoir had operateded for 20 years it's capacity for suspended material retention was found to have dropped from 90 to 0%. This zero retentive capacity of the reservoir for suspended matter, provides optimistic prospects for future water management within the reservoir. (See also W90-00006) (Sand-PTT)
W91-00005

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM: XX. LONG-TERM CHANGES IN THE ABUNDANCE AND COMPOSITION OF MICROBIAL COMMUNITIES.
Politechnika Slaska, Gliwice (Poland). Inst. of Engineereing.
J. Mrozowska, and H. Petrycka.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 427-443, 1988. 5 fig, 4 tab, 21 ref.

Descriptors: *Aquatic bacteria, *Dam effects, *Ecosystems, *Goczalkowice Reservoir, *Limnology, *Poland, *Population dynamics, *Reservoirs, *Saprophytic bacteria, *Vistula River, Cycling nutrients, Microbiological studies.

Microbiological analyses were made using standard methods on water samples from the Vistula River, Poland, prior to construction of the Goczalkowice Reservoir. These analyses showed that the river had self-purification abilities indicating a good prognosis for the future reservoir. In the first years after damming up the waters in 1953, the number of saprophytic bacteria greatly fluctuated, and only limited detection of some physiological groups of bacteria, e.g., denitrifying, nitrifying and cellulolytic. Decreasing bacteria numbers toward the dam indicated the possibility of a self-purifying process in the water. Results of microbiological investigations from 1959-1970, conducted in the lower zone of the reservoir, point to a gradual formation of bacterial biocoenosis and thus, a periodic or continuous intensification of specified physiological processes (e.g., denitrification, nitrification) together with the reservoir's stability. Results allow for the assumption that between 1956 and 1966, bacterial microflora development attained a specified balance, whereas between 1967 and 1982, a kind of stability was observed. Microflora stability was displayed by smaller numbers of saprophytic bacteria at relatively low fluctuations of average seasonal and annual numbers of bacteria. Water in the lower zone of the reservoir was relatively clean from the bacteriological point of view, especially after 1967. Thus, it can be said that the physicochemical processes and biological behaviors in the reservoir were conducive to self-purification of the waters. (See also W90-00005) (Sand-PTT)
W91-00006

POPULATIONS, GROWTH, BIOMASS AND PRODUCTION OF FISH IN A SMALL STREAM IN NORTH-WEST POLAND.
Miljoestyrelsen, Silkeborg (Denmark). Freshwater Lab.
E. Mortensen, and T. Penczak.
Ekologia Polska ELPLBS, Vol. 36, No. 3/4, p 445-458, 1988. 3 fig, 5 tab, 42 ref.

Descriptors: *Bullhead, *Fish populations, *Poland, *Population dynamics, *Stream fisheries, *Trout, Biomass, Growth, Streams.

The population density, growth, biomass and production of brown trout, Salmo trutta, and bullhead, Cottus gobio, were investigated in a small stream in Poland. Population densities ranged from 5067 to 9066 fish/ha for brown trout, and 5468 to 7266 fish/ha for bullhead. Mean annual biomass and total production were 10.1 kg/ha and 36.6 kg/ha/yr for brown trout and 19.7 kg/ha and 30.8 kg/ha/yr for bullhead. The O age group production of brown trout was similar to production found in other small streams in Europe. (Author's abstract)
W91-00007

SEASONAL HABITAT USE BY WALLEYE IN A WARMWATER RIVER SYSTEM, AS DETERMINED BY RADIOTELEMETRY.
Iowa Dept. of Natural Resources, Manchester. Northeast District Headquarters.
For primary bibliographic entry see Field 8I.
W91-00009

SALMON STOCKS AND SALMON FISHERIES IN THE BALTIC SEA (ITAMEREN LOHIKANNAT JA LOHENKALASTUS).
Finnish Game and Fisheries Research Inst., Helsinki.
For primary bibliographic entry see Field 8I.
W91-00015

REINTRODUCTION OF SALMON AND SEA TROUT INTO THE VANTAANJOKI AND KYMIJOKI RIVERS (LOHEN JA MERITAIMENEN PALAUTTTAMINEN VANTAANJOKEEN JA KYMIJOKEEN).
Finnish Game and Fisheries Research Inst., Helsinki.
For primary bibliographic entry see Field 8I.
W91-00017

CULTIVATON AND MANAGEMENT OF LANDLOCKED SALMON AND CHARR IN LAKE SAIMAA (SAIMAAN JARVILOHEN JA NIERIAN VILJELY JA HOITO).
Finnish Game and Fisheries Research Inst., Helsinki.
For primary bibliographic entry see Field 8I.
W91-00018

MACROPHYTE ASSOCIATED INVERTEBRATES AND THE EFFECT OF HABITAT PERMANENCE.
Lund Univ. (Sweden). Dept. of Ecology.
A. Hargeby.
OIKOS OIKSAA, Vol. 57, No. 3, p 338-346, 1990. 2 fig, 3 tab, 44 ref.

Descriptors: *Aquatic habitats, *Eutrophic lakes, *Invertebrates, *Limnology, *Macrophytes, *Species composition, Algae, Ecosystems, Population density, Population dynamics, Stonewort.

Invertebrate abundance differed in stands of two characeans Chara tomentosa L. and Nitellopsis obtusa (Desv.) J. Groves in a shallow eutrophic lake. The plants are similar in morphology but differ in growth cycle. In stands of the wintergreen Chara tomentosa, Asellus aquaticus L. (Isopoda) dominated in abundance over Chironomidae (Diptera) and Gammarus lacustris G. O. Sars (Amphipoda) occurred frequently. In stands of N. obtusa, which dies off during winter, Chironomidae dominated, while the abundance of Asellus was one of two orders of magnitude lower than in Chara and Gammarus was not found. Field and laboratory preference tests showed that Asellus and Gammarus did not colonize or prefer Chara over Nitellopsis, suggesting that active avoidance

was not the cause of their low abundance in Nitellopsis. Exclusion of fish for 90 days in a Nitellopsis stand did not increase the density of Asellus, but introduction of Asellus to enclosures showed that the species was able to grow rapidly and reproduce in the habitat. In a recently established Chara stand the species structure of associated invertebrates shifted from a dominance of Chironomidae in September of the first year to a dominance of Asellus the following year. These results support the hypothesis that the die-off of Nitellopsis in autumn limits slow colonizers like Asellus and Gammarus from establishing dense populations in this habitat. The invertebrate community in this seasonally changing habitat is thus suggested to be in an early phase of colonization, where animal interactions are less important and the species composition is mainly determined by colonization ability. In the more permanent Chara habitat, density dependent animal interactions are suggested to determine the abundance and species composition. (Author's abstract)
W91-00052

LATERALLY AVERAGED HYDRODYNAMICS MODEL FOR RESERVOIR PREDICTIONS.
Toronto Univ. (Ontario). Dept. of Physics.
S. R. Karpik, and G. D. Raithby.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 783-798, June 1990. 8 fig, 30 ref.

Descriptors: *Computer models, *Density currents, *Mathematical models, *Model studies, *Reservoirs, *Thermal stratification, Turbulent flow, Water quality.

The prediction of flows in reservoirs is of significant practical interest from a water quality perspective, the choice of an appropriate withdrawal point for drinking water, and the use of the cooling capacity of reservoirs for waste heat rejection. LAHM is a new two-dimensional model for the prediction of thermally stratified reservoir flows. Unlike many other reservoir models, this model does not employ the hydrostatic approximation. The full general orthogonal three-dimensional anelastic equations of motion are laterally averaged to produce a set of two-dimensional equations in a vertical plane that is oriented along the principal axis of the reservoir. Using an orthogonal boundary fitted mesh, the governing differential equations are rendered discrete by a finite volume technique. The resulting set of coupled difference equations for momentum, mass, and energy are solved by a method that is especially appropriate to reservoirs in which the depth is small compared to the length. The model applies to turbulent flow and to cases where the flow is somewhat nonuniform in the lateral direction if turbulence and dispersion models are added. Comparisons between the predictions of the model and previously published flume data show that the model is well able to predict the important features of density underflows. (Author's abstract)
W91-00062

WATER WAVES GENERATED BY DISTANT LANDSLIDES.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 3, p 307-322, 1988. 5 fig, 18 ref.

Descriptors: *Landslides, *Mathematical models, *Model studies, *Reservoirs, *Wave runup, *Waves, Tsunamis.

Waves generated in a reservoir by a landslide were modeled by injecting an instantaneous point source of fluid through the bottom of a reservoir of infinite extent. Linearized wave theory was used to calculate solutions for dispersive waves when the wave patterns are either axisymmetric or one dimensional in a reservoir of constant depth and infinite extent. This assumes that times are large relative to the duration time of the landslide and that distances are large relative to a characteristic horizontal dimension of the volume of water displaced by the slide material. Solutions were obtained for two-dimensional and axisymmetric problems, and the asymptotic forms of these solutions were used to obtain expressions for maximum wave amplitudes, length, period, and position. Since the solution assumes a constant reservoir depth, and since maximum wave amplitudes always occur along shorelines of sloping beaches, it is suggested that these solutions may be of most use for providing boundary conditions for models of wave runup on sloping beaches. A comparison with experimental results was made, and agreement between the calculated and measured results is found to be good. (Author's abstract)
W91-00071

WATER BALANCE OF LAKE ROTOITI, NORTH ISLAND: FLOODS AND SHORT-CIRCUITING OF INFLOWS FROM LAKE ROTORUA.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
R. H. Spigel.
Journal of Hydrology (New Zealand) JLHYAD, Vol. 28, No. 1, p 47-61, 1989. 4 fig, 2 tab, 27 ref, append.

Descriptors: *Floods, *Hydrologic budget, *Lake Rotoiti, *Lake Rotorua, *Lakes, *Water circulation, Density currents, New Zealand, Rainfall, Storms, Streamflow, Surface-groundwater relations.

The water balance of Lake Rotoiti, North Island, New Zealand, was examined to clarify the role of floods and residual flows in the transport of Lake Rotorua water into the main body of Lake Rotoiti. A 28-yr (1957-1984) dataset for inflows, outflows, water levels, rainfall, and evaporation was used to construct a long-term monthly water balance and to compare daily flows for the entire study period. Four storms were examined in detail to explain observed lake level rises during the storms. The transport of Lake Rotorua water to Lake Rotoiti during storms is negligible compared with transport governed by density currents, and lake level rises during storms are a response more to rainfall on the lake than to inflows from Lake Rotorua. The residual term in the water balance reflects groundwater input, resulting in a net westward flow through the lake. In the absence of density currents this flow reinforces the tendency of Lake Rotorua water to short-circuit (i.e., to flow directly to the outlet of Lake Rotoiti without mixing with the main body of the lake) because of the proximity of the lake inlet and outlet at the western end of the lake. (Author's abstract)
W91-00077

SEASONAL VARIABILITY IN THE SENSITIVITY OF FRESHWATER LENTIC COMMUNITIES TO A CHRONIC COPPER STRESS.
Miami Univ., Oxford, OH. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-00196

SHORT-TERM PRODUCTIVITY RESPONSES OF ALGAE AND BACTERIA TO ZOOPLANKTON GRAZING IN TWO FRESHWATER LAKES.
Georgia Univ., Athens. Inst. of Ecology.
S. A. Shoenberg.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 395-410, June 1990. 7 fig, 4 tab, 71 ref. National Science Foundation Grant BSR 82-15587.

Descriptors: *Algae, *Bacteria, *Lakes, *Limnology, *Plankton, *Productivity, Biomass, Chlorophyll a, Dissolved organic carbon, Primary productivity, Tracers, Tritium.

The specific productivities of algae and bacteria were measured in short-term (4 day) experiments consisting of enclosures with natural or reduced zooplankton biomass. Experiments were repeated five times over a season in each of two lakes that differed in the background concentration of dissolved organic carbon (DOC). Algal biomass as estimated by chlorophyll a was suppressed in enclosures with ambient grazer levels in six of ten experiments and enhanced in one experiment. Distribution of chlorophyll among net and nanoplankton was not significantly affected by grazing. Relative to enclosures with reduced zooplankton, normal grazer biomass (97-466 micrograms/L dry weight) enhanced specific algal productivity in only one of five experiments in the low DOC lake and had no effect in all five experiments in the high DOC lake. The main effect of grazers on algae was through removal of biomass rather than through indirect changes in turnover rate. Between experiments, bacterial density was either unaffected, or mildly enhanced (4-87%) in enclosures with ambient macrozooplankton compared to those with reduced levels. Bacterial productivity and turnover estimated by incorporation of tritium labelled thymidine into DNA showed different responses across experiments; increasing, declining or remaining the same with grazer manipulation. This variability was not related to differences in dissolved primary production or to background DOC between lakes or experiments. Comparison of bacterial productivities based on thymidine incorporation rates with changes in cell densities indicated that control of bacterial loss processes by macrozooplankton is more important than control of growth rates. (Author's abstract)
W91-00418

DISTRIBUTION OF MICRO-ARTHROPODS IN SOME SOUTHERN ENGLISH STREAMS: THE INFLUENCE OF PHYSICOCHEMISTRY.
Queen Mary Coll., London (England). School of Biological Sciences.
S. R. Rundle, and A. G. Hildrew.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 411-431, June 1990. 8 fig, 8 tab, 59 ref, append.

Descriptors: *Copepods, *Waterfleas, *Watermites, *England, *Physicochemical properties, *Running waters, *Species diversity, *Statistical analysis, *Streams, Benthic fauna, Conductivity, Copepods, Harpacticoida, Hydrachnellae, Hydrogen ion concentration, Mathematical analysis, Multivariate analysis, Regression analysis, Seasonal distribution, Temperature effects, Waterfleas.

Micro-arthropods were surveyed during October 1986 at thirty stony, stream riffle sites in the Ashdown Forest, southern England. The importance of a number of physicochemical variables in determining both the distribution of micro-arthropod taxa and community structure was assessed. Acidic sites had impoverished fauna. Total micro-arthropod species richness and densities were highest under circumneutral conditions, and the same patterns were shown by the Hydrachnellae, Harpacticoida and Cladocera. A number of species seemed indifferent to acidic conditions and were widespread and, as a group, the cyclopoid copepods showed no relationship with pH. Multiple regression showed that other environmental variables, in particular annual mean temperature and maximum discharge, were also important in explaining the between-site distribution of separate micro-arthropod groups and individual species. Other multivariate techniques (ordination, classification and multiple discriminant analysis) showed that impoundment linkage, source distance and conductivity, along with pH, were the most important variables in explaining patterns of species composition between sites. (Author's abstract)
W91-00419

COMPARATIVE STUDY OF MATHEMATICAL MODELS FOR THE RELATIONSHIP BETWEEN WATER TEMPERATURE AND BROOD DEVELOPMENT TIME OF GAMMARUS FOSSARUM AND G. ROESELI (CRUSTACEA: AMPHIPODA).
Vienna Univ. (Austria). Limnologische Lehrkanzel.
M. Pockl, and W. Timischl.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 433-440, June 1990. 2 fig, 2 tab, 21 ref.

Descriptors: *Amphipods, *Aquatic animals, *Crustaceans, *Growth rates, *Limnology, *Mathematical models, *Model studies, *Physical properties, *Streams, *Water temperature, Austria, Com-

parison studies, Hatching, Running waters, Statistical analysis.

The relationship between water temperature (T) and brood development time (d days for embryonic development time plus 'post hatch time') was investigated experimentally using animals from four populations of Gammarus fossarum (populations 1-4) and two populations of G. roeseli (populations 5 and 6) in Austrian streams. Eleven mathematical models were examined as suitable functions to describe the relationship between d and T. The models were compared with respect to their goodness-of-fit and suitability for further quantitative, statistical analyses of intraspecific and interspecific differences between natural populations of G. fossarum and G. roeseli. Statistical analyses were performed with logarithmically transformed values of d, in order to provide homogeneous variances between the different constant temperatures used. A three-parameter model was found to be the most suitable for the data. (Author's abstract)
W91-00420

INTERACTIONS AMONG NUTRIENTS, ALGAE AND INVERTEBRATES IN A NEW ZEALAND MOUNTAIN STREAM.
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2E.
W91-00422

COMPETITION AND COEXISTENCE IN SUBMERGED AQUATIC PLANT COMMUNITIES: THE EFFECTS OF SPECIES INTERACTIONS VERSUS ABIOTIC FACTORS.
Alberta Univ., Edmonton. Dept. of Zoology.
P. A. Chambers, and E. E. Prepas.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 541-550, June 1990. 4 fig, 3 tab, 34 ref.

Descriptors: *Competition, *Lakes, *Limnology, *Species composition, *Species diversity, *Submerged plants, Alberta, Aquatic plants, Biomass, Canada, Chlorophyta, Long Lake, Myriophyllum, Phosphorus, Physicochemical properties, Sediments, Water depth.

Aquatic plant biomass and species composition were studied at three sites in Long Lake, Alberta, Canada, to examine the role of biotic and abiotic factors in determining species diversity. Results of controlled in situ experiments to test for interspecies competition showed that biomass of plants in four different mixed communities did not increase in response to selected species removals ($P>0.1$, $n=6$). In contrast, biomass of the dominant taxa (Myriophyllum exalbescens, Ceratophyllum demersum and Chara sp.) were correlated ($P<0.5$) with abiotic factors (i.e. distance from shore, water depth, sediment exchangeable phosphorus concentration and/or sediment organic content). These results suggest that interspecific competition between naturally coexisting species of submerged aquatic plants is slight and that spatial heterogeneity of differential utilization of abiotic resources promotes species diversity in submerged plant communities. (Author's abstract)
W91-00423

GROWTH RESPONSES OF PLANKTONIC DESMID SPECIES IN A TEMPERATURE-LIGHT GRADIENT.
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
P. F. M. Coesel, and K. Wardenaar.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 551-560, June 1990. 5 fig, 2 tab, 26 ref, append.

Descriptors: *Aquatic life, *Chlorophyta, *Desmids, *Growth, *Growth rates, *Lakes, *Lighting, *Limnology, *Temperature gradient, *Trophic level, Culturing techniques, Distribution patterns, Mesotrophy, Nutrient concentrations, Oligotrophy, Seasonal variation.

The intrinsic growth rates in a number of planktonic desmid species originating from lakes with different trophic status, under nutrient-saturated conditions at various combinations of temperature and light were assessed. Isolates of twelve planktonic desmid species were tested for their growth response in a batch culture, using an apparatus that generates cross gradients of temperature and light intensity. Up to 15 C, growth was mainly temperature-limited. At higher temperatures, there was an increasing effect of light limitation. Optimal growth temperatures were in the range 25-30 C. Highest specific growth rates varied from 0.28 to 1.34 per day. Species with lowest growth rates originated from oligo-mesotrophic habitats, those with highest growth rates originated from eutrophic ones. Results suggest that eutrophic species are characterized by a lower affinity to limiting nutrients than oligotrophic ones and thus are disadvantaged in oligotrophic habitats. The marked differences between the species in their growth response to various light-temperature combinations may be of help in explaining distributional and seasonal patterns of desmid species in nature. (Agostine-PTT)
W91-00424

RESPONSES OF ZOOPLANKTON AND ZOOBENTHOS TO EXPERIMENTAL ACIDIFICATION IN A HIGH-ELEVATION LAKE (SIERRA NEVADA, CALIFORNIA, U.S.A).
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W91-00425

MINERALIZATION, PORE WATER CHEMISTRY AND PHOSPHORUS RELEASE FROM PEATY SEDIMENTS IN THE EUTROPHIC LOOSDRECHT LAKES, THE NETHERLANDS.
Limnologisch Inst., Nieuwersluis (Netherlands).
A. J. C. Sinke, A. A. Cornelese, P. Keizer, O. F. R. Van Tongeren, and T. E. Cappenberg.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 587-599, June 1990. 5 fig, 4 tab, 43 ref.

Descriptors: *Eutrophic lakes, *Interstitial water, *Lakes, *Mathematical studies, *Mineralization, *Peat, *Phosphorus, *Sediments, *The Netherlands, *Water chemistry, Ammonia, Methane, Organic matter, Redundancy analysis, Seasonal variation, Sediment-water interfaces.

Phosphorus release experiments were carried out under standard laboratory conditions to relate the seasonal variation in pore water chemistry to environmental variables and thus gain insight into the phosphorus regeneration in peaty sediments. Pore water chemistry in peaty sediment was monitored for a year at two representative locations of the eutrophic shallow Loosdrecht lakes, The Netherlands. Phosphorus fluxes over the sediment-water interface were calculated using measured concentration gradients in the pore water and compared to fluxes measured under laboratory conditions. Results were analyzed with redundancy analysis to detect patterns of variation in pore water chemistry and in measured and calculated fluxes, that could be ascribed to environmental variables. It was demonstrated that phosphorus fluxes measured in long-term laboratory incubations were not correlated to any pore water characteristics. Initial phosphorus fluxes measured in sediment columns, which varied between -7.7 and 1330 micromoles/sq m/day, were correlated significantly to the calculated phosphorus flux over the sediment-water interface. The high correlation between calculated fluxes of ammonia, phosphorus and methane and measured initial flux of phosphorus, conclusively pointed to mineralization of organic matter as the driving force for phosphorus release from the sediment. Redundancy analysis demonstrated that the rates of mineralization and phosphorus release were only weakly related to temperature. They appeared to be especially stimulated by the autumnal decrease in temperature which was probably related to an extra input of organic matter. (Author's abstract)
W91-00426

WATER TEMPERATURE IN A STREAM GRAVEL BED AND IMPLICATIONS FOR SALMONID INCUBATION.
Freshwater Biological Association, Ambleside (England). Windermere Lab.
For primary bibliographic entry see Field 8I.
W91-00427

MANIPULATING LAKE COMMUNITY STRUCTURE: WHERE DO WE GO FROM HERE.
York Univ., Toronto (Ontario). Dept. of Biology.
D. J. McQueen.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 613-620, June 1990. 1 fig, 69 ref.

Descriptors: *Aquatic life, *Biocontrol, *Ecology, *Fish management, *Food chains, *Freshwater, *Lakes, *Limnology, Algae, Algal blooms, Aquatic plants, Biomass, Competition, Cycling nutrients, Deep water, Fish, Grazing, Lake management, Macrophytes, Physical properties, Shallow water, Water quality.

More than 10 years experience with whole lake pelagic manipulation has suggested some general trends applicable to all freshwater pelagic communities and some specific trends related to lake depth. Among the general trends is the observation that in shallow lakes, changes in fish community structure are more likely to have cascading impacts on phytoplankton than are changes in deep lakes. In shallow lakes, fish removal frequently results in decreased turbidity which is associated with the development of dense macrophyte populations and significant reductions of algal standing stocks. The mechanisms involve: increased grazing by zooplankton, the removal of fish induced bioturbation and nutrient recycling. and direct and indirect macrophyte effects (shading, zooplankton refuges and competition for nutrients). In shallow lakes, where planktivore biomass can be regulated and macrophyte development is acceptable, fish biomanipulations are likely to result in reduced algal populations and improved water quality. In deep lakes, where macrophytes are not as important, long-term effects of fish manipulations are strongly dependent upon the probability of nongrazable algal bloom development. This is determined by many factors (chemical, physical and grazer related) which modify the impact that grazers have on phytoplankton biomass. In deep lakes, successful fish biomanipulations may only be effective when chemical and physical factors are altered to produce algal species compositions that permit strong top-down control of prey by predators. (Author's abstract)
W91-00428

MONITORING LAKE NASSER BY SPACE SENSING.
Boston Univ., MA. Center for Remote Sensing.
For primary bibliographic entry see Field 7B.
W91-00473

EFFECTS OF COPPER (II) ON THE PRODUCTION OF TRIHALOMETHANES IN MODEL AND NATURAL WATERS.
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
For primary bibliographic entry see Field 5B.
W91-00529

FIVE YEAR PROGRAM STRATEGY FOR THE GREAT LAKES NATIONAL PROGRAM OFFICE, FY 1989-1993.
Environmental Protection Agency, Chicago, IL. Great Lakes National Program Office.
For primary bibliographic entry see Field 5G.
W91-00552

INTERACTIONS OF CONTAMINANTS WITH SEDIMENT AND WATER IN RESERVOIRS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W91-00560

SYLVAN LAKE RESTORATION PROJECT.
Utility Engineering Corp., Rapid City, SD.

For primary bibliographic entry see Field 5G.
W91-00562

LAKE RESTORATION PROJECT, NORTH HUDSON PARK LAKE, BERGEN, NEW JERSEY.
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
For primary bibliographic entry see Field 5G.
W91-00563

DREDGING OF NORTH PARK LAKE, COUNTY OF ALLEGHENY, PENNSYLVANIA.
Pennsylvania Dept. of Environmental Resources, Harrisburg.
For primary bibliographic entry see Field 5G.
W91-00564

PESTICIDES AND WETLANDS OVERSEAS: A FRAMEWORK FOR MITIGATING ADVERSE IMPACTS.
California Univ., Berkeley. Graduate School of Public Policy.
For primary bibliographic entry see Field 5G.
W91-00570

RESOURCE LIMITATION IN A STREAM COMMUNITY: PHOSPHORUS ENRICHMENT EFFECTS ON PERIPHYTON AND GRAZERS.
Academy of Natural Sciences of Philadelphia, PA.
D. D. Hart, and C. T. Robinson.
Ecology ECOLAR, Vol. 71, No. 4, p 1494-1502, August 1990. 1 tab, 80 ref. NSF Grant DEB-8111305 and Grant BSR-8312629.

Descriptors: *Caddisflies, *Ecology, *Limiting nutrients, *Periphyton, *Phosphorus, *Stream biota, Benthic fauna, Biomass, Enrichment, Field tests, Grazing, Insects, Michigan, Population density.

A field experiment was used to test whether stream periphyton was nutrient limited, and if so, whether the grazing insects that consumed this resource were food limited. Eight replicate wooden flumes were placed in an unshaded riffle in Augusta Creek, a third-order, hardwater trout stream in southwestern Michigan. Phosphorus (P), in the form of calcium phosphate, was added to four of these flumes for 105 days. The average concentration of soluble reactive phosphorus (SRP) maintained in P-enriched flumes (85 micrograms/L) was greater than 5 times as great as in control flumes (15 micrograms/L). After 77 days of nutrient enrichment, periphyton biomass per unit area on substrates with reduced grazer densities was 1.8 times as great in P-enriched flumes as in control flumes. The larvae of two species of grazing caddisflies (Leucotrichia pictipes and Psychomyia flavida) in P-enriched flumes also had higher individual mass, developmental rates, and population densities. Theses responses resulted in standing crops of final-instar larvae in P-enriched flumes that were 2.1 times and 1.5 times as great as those in control flumes for Psychomyia and Leucotrichia, respectively. This demonstration of food limitation supplements previous behavioral studies showing that both grazer species aggressively defend feeding territories, and contributes to a growing body of evidence suggesting that resource limitation is more important in some stream food webs than previously recognized. Resource limitation of these grazer populations may be due in part to the rarity of catastrophic flooding and drying in Augusta Creek. Such stable flows could permit consumer populations to reach higher densities than in frequently disturbed streams. (Author's abstract)
W91-00618

REDUCTION OF PHOSPHORUS AND CHLOROPHYLL A CONCENTRATIONS FOLLOWING CACO3 AND CA(OH)2 ADDITIONS TO HYPEREUTROPHIC FIGURE EIGHT LAKE, ALBERTA, CANADA.
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 5F.
W91-00625

INFERRED EFFECTS OF LAKE ACIDIFICATION ON DAPHNIA GALEATA MENDOTAE.
Ontario Ministry of the Environment, Sudbury.
For primary bibliographic entry see Field 5C.
W91-00626

NUTRIENT STATUS OF OMBROTROPHIC PEAT BOGS.
Connecticut Univ., Storrs. Dept. of Ecology and Evolutionary Biology.
A. W. H. Damman.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 5-14, 1990. 11 fig, 1 tab, 23 ref. NSF Grants GS-8744 and DEB-7905195.

Descriptors: *Bogs, *Cycling nutrients, *Limnology, *Nutrients, *Ombrotrophic bogs, *Peat bogs, *Wetlands, Climates, Fire, Flow rates, Hydrology, Organic matter, Spatial distribution, Water chemistry.

The nutrient status of ombrotrophic bogs is controlled by: (1) atmospheric inputs; (2) processes affecting ion concentrations in bog water; and (3) processes affecting nutrient supply. Geographic trends result from nutrient input differences and variations in length of vegetative season and temperatures occurring during the growing season. Differences in peat accumulation and water flow rate appear to play an important role, but are rarely considered when accounting for regional differences in fertility. The chemistry of bog water changes seasonally. These changes also show geographic trends because they are under climatic control. The rate of organic matter accumulation, water flow, fire, and other disturbances are the principal factors causing fertility differences within ombrotrophic bogs. Because these differences in nutrient supply often are not reflected in the chemical composition of the bog water, water chemistry appears to be a poor indicator of fertility differences in ombrotrophic bogs. The role of organic matter accumulation and water flow in causing local and regional differences in ombrotrophic bogs is overlooked in most studies and warrants closer study. (Rochester-PTT)
W91-00640

COMPARATIVE DEVELOPMENT OF BOGS AND FENS IN CENTRAL SWEDEN: EVALUATING THE ROLE OF CLIMATE CHANGE AND ECOSYSTEM DEVELOPMENT.
Harvard Univ., Petersham, MA. Harvard Forest.
D. R. Foster, and H. A. Jacobson.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 15-26, 1990. 8 fig, 65 ref. NSF Grant BSR-8906386.

Descriptors: *Bogs, *Ecosystems, *Fens, *Limnology, *Paleoclimatology, *Peat bogs, *Sweden, *Wetlands, Climates, Geomorphology, Hydrology, Paleolimnology, Water chemistry.

The role of climate change versus autogenic processes and local factors in the development of three mires of Sweden is being studied. Studies focus on a comparison of raised bogs and minerotrophic bogs and are addressing three critical aspects of mire development: initiation, growth, and landform dynamics. Results suggest that autogenic processes, especially hydrologic changes that accompany peat accumulation, play a major role in driving mire development and controlling stratigraphic changes including peat type and peat accumulation rates. Both the raised bogs studied were initiated approximately 6000 yr B.P., whereas the fen dates to 9040 yr B.P. All three mires exhibit progressive lateral expansion through time from initiation to the present as documented by a series of basal radiocarbon dates. Similarly, the formation of hummock-hollow topography and pools occurs progressively through time and appears depend on local hydrology within the mire. The results suggest that the interplay of autogenic and allogenic factors control mire development and argue for careful interpretation of paleoenvironmental information from peat stratigraphy. The work shows the need for further hydrological study of mires, comparative investigation of mires and regional environment, and consideration of minerotrophic mires and more complex models of mire formation. (Author's abstract)
W91-00641

VEGETATION AND PALEOECOLOGY OF A BOG COMPLEX IN S FINLAND.
Oulu Univ. (Finland). Dept. of Botany.
A. Huttunen.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 27-37, 1990. 7 fig, 1 tab, 45 ref.

Descriptors: *Bogs, *Finland, *Limnology, *Paleoecology, *Vegetation, *Wetlands, Cottongrass, Ecosystems, Fens, Forests, Nutrients, Ombrotrophic bogs, Sedges, Sphagnum, Succession.

The bog of Ylimysneva is morphologically typical of the region of concentric raised bogs comprising the coast of Finland and southern Ostrobothnia. The ombrotrophic mire vegetation has regionally typical features, but the mire complex has quite large minerotrophic parts as well. The vertical distribution of some elements was studied in two monoliths. A radiocarbon-dated pollen diagram covers most of the Holocene history of the vegetation. The macrosubfossil diagram reflects local history of the site from a shore lake to a poor mire. The open swamp vegetation was replaced by a forest swamp, with further succession towards a poorer vegetation, ultimately leading to a fen dominated by sedges and cottongrass. Only in the uppermost half meter does the vegetation indicate indifferent conditions; Sphagnum magellanicum is a typical indifferent plant found on the boundary between minerotrophic and ombrotrophic phases. (Rochester-PTT)
W91-00642

PRESERVATION OF PLANT POLYMERS IN PEAT AND LIBERATION OF THEIR MONOMERS DUE TO ARTIFICIAL DRAINAGE.
Oulu Univ. (Finland). Dept. of Biochemistry.
P. Lahdesmaki, and R. Piispanen.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 39-43, 1990. 3 fig, 1 tab, 33 ref.

Descriptors: *Bogs, *Environmental impact, *Finland, *Peat, *Wetlands, Amino acids, Ammonia, Carbon dioxide, Cellulose, Chemical reactions, Drainage, Drying, Enzymes, Forests, Lignin, Polymers, Proteins, Starch.

Concentrations of cellulose, protein, lignin, and starch in peat from two ombrotrophic pine bogs in Muhos and Ylikiiminki, northern Finland, were determined as a function of peat depth. The concentration of cellulose decreased to about half of the original concentration at a depth of 1 m and to 1/3 of the original concentration at 2 m, whereas the concentrations of protein and lignin remained relatively constant. Starch was found only in the surface peat. The activities of cellulase, protease, and polyphenoloxidase varied between 50 and 100 picomoles of liberated monomers/sec (pkat) per kg dry weight, with of polyphenol-oxidase increasing as a function of peat depth. Drying of peatlands by artificial drainage liberates a number of amino acids and ammonia from the peat, with marked geobotanical and environmental consequences, including an acceleration of forest growth and an increase in carbon dioxide production. (Author's abstract)
W91-00643

PERIODIC MOISTURE FLUCTUATION AS A FACTOR AFFECTING MIRE VEGETATION.
Oulu Univ. (Finland). Dept. of Botany.
J. Laitinen.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 45-55, 1990. 1 tab, 53 ref.

Descriptors: *Limnology, *Mires, *Soil water, *Swamps, *Vegetation, *Wetlands, Classification, Ecology, Finland, Flooding, Grasses, Hydrology, Nutrients, Sedges.

A significant factor for the classification of mire vegetation-nutrient status is often the fluctuation of moisture and its forms in the vegetation. The most distinct periodic moisture fluctuation is seen in flooded heaths. Flooded conditions are combined

with the concept 'surface-water influence' within which it is possible to separate out 'true swamp influence' and an extreme case 'flood and desiccation influence.' Flooding, combined with desiccation, must be regarded as a stress factor for plants that strongly controls the flora at a site. Certain mire species of the flark and intermediate levels are very tolerant of desiccation. In the case of hummock-level mire vegetation, examples can be presented in which moisture fluctuations may have had an influence on the vegetation. The species group indicative of flood and desiccation influence, the extreme case of surface-water influence, includes Juncus filiformis, Carex nigra, C canescens, C magellanica, C lasiocarpa, Eriophorum angustifolium, Warnstorfia fluitans, and Polytrichum commune. Fluctuation in moisture is unquestionably a variable with a floristically characterized gradient that should be considered when defining the ecological bases of the mire type system. It has importance at every nutrient level and in terms of both mire-inherent and supplementary nutrient effects, with the exception of the spruce mire influence. (Author's abstract)
W91-00644

CONSTANT OR INCREASING NITROGEN CONCENTRATIONS IN SPHAGNUM MOSSES ON MIRES IN SOUTHERN SWEDEN DURING THE LAST FEW DECADES.
Lund Univ. (Sweden). Dept. of Ecology.
N. Malmer.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 57-65, 1990. 3 fig, 1 tab, 33 ref.

Descriptors: *Acid rain, *Limnology, *Mires, *Nutrients, *Sphagnum, *Sweden, *Wetlands, Air pollution, Ash, Biomass, Calcium, Chemical analysis, Growth, Iron, Magnesium, Manganese, Nitrogen, Phosphorus, Potassium, Sodium, Sulfur.

The concentrations of N, P, Na, K, Mg, Ca, Mn, Fe, and acid-insoluble ash (AIA) during the periods 1955-1958 and 1979-1985 in samples of Sphagnum mosses from three mires in the central part of the Swedish upland were compared. Only minor changes in concentrations were found, particularly an increase in N and a decrease in P in some of the samples. It is suggested that the Sphagnum mosses have responded to atmospheric deposition of N and S during the last few decades mainly through an increased growth and biomass accumulation. (Author's abstract)
W91-00645

DIVERGENT SUCCESSIONS IN MIRES, A COMPARATIVE STUDY.
Uppsala Univ. (Sweden). Dept. of Ecological Botany.
H. Sjors.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 67-77, 1990. 2 fig, 65 ref.

Descriptors: *Ecology, *Limnology, *Mires, *Succession, *Waterlogging, *Wetlands, Bogs, Classification, Europe, Fens, Hydrology, Peat.

The patterns in both ombrotrophic and minerotrophic mires are regarded as resulting from divergent succession under the influence of hydrology, causing wetter parts to have less net peat accumulation than drier parts. The rate of decay, which is more decisive for the rate of peat accumulation than is primary production, seems to have its maximum at the hollow level in ombrotrophic sites (bogs) where the maximum peat accumulation then would be at a higher level, such as under hummocks. In minerotrophic sites (fens) the net accumulation usually is smaller and, in the north, would have its maximum in 'lawns' and not in waterlogged parts, whereas in warmer climates it would be located in the 'carpets,' which are wetter than the 'lawns.' This would explain the considerably greater waterlogging needed to produce flarks in fens than hollows in bogs, and the absence of typical patterns in southern lowland fens. The more northern distribution of patterning in fens than in bogs could be related, at least in part, to the abundance of meltwater on the northern fens and 'mixed mires' of the aapa type. Fens also exhibit different mud-bottom network patterns. (Author's abstract)
W91-00646

SYNOPSIS AND NUMERICAL ANALYSIS OF THE PRE-, SUB-, AND LOW-ALPINE MIRE VEGETATION OF THE ULEBERG-SKRUBBEN AREA, NORTH NORWAY.
Tromsoe Univ. (Norway). Inst. for Biologi og Geologi.
K. D. Vorren, and B. E. Johansen.
Aquilo, Ser. Botanica ASBOD8, No. 28, p 79-92, 1990. 5 fig, 4 tab, 29 ref.

Descriptors: *Ecology, *Limnology, *Mires, *Norway, *Swamps, *Vegetation, *Wetlands, Classification, Cluster analysis, Finland, Numerical analysis, Soil properties, Trophic level, Water chemistry.

Vegetation of mires in the Uleberg-Skrubben area of Norway was examined and a synopsis and numerical analysis of the vegetation was conducted. The synopsis was achieved by numerical treatment of vegetation relevees. Thirteen (plus one) different vegetation units (noda) and nine variants (subunits) were established by group-average clustering of qualitative data (presence/absence). A new clustering of the quantitative 'average relevees,' constructed on the basis of the frequency data, showed that the original 13 (+1) vegetation units were differentiated on a level higher than the association syntaxon. According to both numerical and binary clusterings of the total species assemblage and the species assemblage above 40% frequency, 5-8 clusters representing the total mire vegetation of the area could be distinguished. The clusters are thought to represent syntaxa at the alliance level or higher. The establishment of a new syntaxon on a higher level is suggested: a boreal (sub-alpine and pre-alpine) Salix borealis-Filipendula ulmaria-Sphagnum warnstorfii vegetation, representing the O2-rich swamps. The original, numerically based, 13 (+1) vegetation units match the Finnish mire vegetation better than the Central European one. Numerical treatment of important soil chemical and physical parameters result in three main clusters: (1) eu-, and mesotrophic communities characterizing open and wooded sub-, and pre-alpine mires with Sphagnum warnstorfii, (2) oligotrophic Sphagnum fuscum and Sphagnum lindbergii communities, and (3) mountain mires and rich lowland mires influenced by spring water from dolomite. Field pH and conductivity records support the soil chemistry data. (Author's abstract)
W91-00647

OCCURRENCE OF HYPOLIMNETIC BLOOMS OF THE PURPLE SULFUR BACTERIUM, THIOPEDIA ROSEA, AND THE GREEN SULFUR BACTERIUM, CHLOROBIUM LIMICOLA, IN AN AUSTRALIAN RESERVOIR.
University of New England, Armidale (Australia). Dept. of Resource Engineering.
For primary bibliographic entry see Field 5C.
W91-00652

PHYSICOCHEMISTRY AND VEGETATION OF PICCANINNIE PONDS, A COASTAL AQUIFER-FED POND IN SOUTH-EASTERN SOUTH AUSTRALIA.
Monash Univ., Clayton (Australia). Dept. of Botany.
O. Scholz.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 41, No. 2, p 273-246, 1990. 3 fig, 5 tab, 19 ref.

Descriptors: *Aquatic habitats, *Aquatic plants, *Australia, *Coastal marshes, *Limnology, *Physicochemical properties, *Ponds, *Wetlands, Ecology, Macrophytes, Piccaninnie Ponds, Succession, Surface-groundwater relations, Vegetation.

The aquatic vegetation and physicochemistry of Piccaninnie Ponds are described and recent annual losses of aquatic vegetation were investigated. The aquifer-derived waters of the Ponds are characterized by their clarity, low nutrient content, low salinity, and lack of thermal and chemical stratification. In 1985, large areas of aquatic vegetation within the Ponds degraded and were lost. Subsequent faster regeneration of denuded areas by Ruppia polycarpa resulted in the displacement of Lepilaena cylindrocarpa. The annual uprooting of R. polycarpa, which has occurred since, results from Ruppia's comparatively poorer anchorage capacity in the loose sediment floc. Gradual expansion of L. cylindrocarpa into freshly uprooted regions restricts the regrowth of R. polycarpa and hence the area susceptible to denudation in the following year. It is expected that the displacement of R. polycarpa will continue until there remain only small, isolated stands, which will be prevented from uprooting by the root matrix of the surrounding vegetation. (Author's abstract)
W91-00653

GRAZING ON BACTERIA BY ZOOPLANKTON IN AUSTRALIAN BILLABONGS.
Murray-Darling Freshwater Research Centre, Albury (Australia).
P. I. Boon, and R. J. Shiel.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 41, No. 2, p 247-257, 1990. 3 fig, 3 tab, 32 ref.

Descriptors: *Australia, *Bacteria, *Billabongs, *Limnology, *Zooplankton, Bacteriovory, Food habits, Rotifers, Staining.

Five species of rotifer (Brachionus lyratus, Conochilus dossuaris, Keratella cochlearis, K. quadrata, and Trichotria tetractis) ingested bacteria at prey density of 5-7 billion cells/L and a sixth species (K. procurva) did so at a higher bacterial concentration (40 billion cells/L). Gastropus minor, Polyarthra vulgaris, Synchaeta pectinata, and Trichocerca similis were not bacteriovores. Fluorescent-stained (5-(4,6-dichlorotriazin-2-yl)aminofluorescein or acridine orange) bacteria were not suitable for determining which rotifers were potential grazers. However, bacteriovory was detected easily with bacteria stained with safranin-red or methylene-blue. Clearance rates for the zooplankton community larger than 51 micrometer, determined with 3H-thymidine-labeled bacteria, varied from <0.1-71 mL/hr, but usually were <5 mL/hr. Significant grazing was detected in >200 micrometer, 90-200 micrometer, and 51-90 micrometer fractions. It was impossible to ascribe bacteriovory to discrete taxonomic groups because zooplankton were not separated completely by these mesh sizes. (Author's abstract)
W91-00654

LAKE THETIS, WESTERN AUSTRALIA: AN EXAMPLE OF SALINE LAKE SEDIMENTATION DOMINATED BY BENTHIC MICROBIAL PROCESSES.
Geological Survey of Western Australia, Perth.
K. Grey, L. S. Moore, R. V. Burne, B. K. Pierson, and J. Bauld.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 41, No. 2, p 275-300, 1990. 13 fig, 6 tab, 45 ref.

Descriptors: *Australia, *Limnology, *Microorganisms, *Saline lakes, *Stromatolites, Algal mats, Benthos, Climates, Coastal waters, Cyanophyta, Diatoms, Lake Thetis, Precambrian era.

Lake Thetis is a saline coastal lake in southwestern Australia, a region of winter rainfall and summer drought. The lake demonstrates the close relationships between environmental variation and the nature of resident benthic microbial communities. Crenulate cyanobacterial mats occur in the low-lying areas adjacent to the lake. Lithified stromatolites with patches of living coccoid cyanobacterial mat characterize the littoral area, whereas a thick flocculent mat composed of phototrophic prokaryotes (principally the purple sulfur bacteria) and diatoms has accumulated in the central lake basin. Lake Thetis is distinguished from other coastal saline lakes by the presence of the unusual flocculent mat and by the juxtaposition of this microbial community to the marginal lithified stromatolites. Further, some of the latter exhibit internal digitate columnar branching, which, though common in

Precambrian examples, is rare in modern environments. (Author's abstract)
W91-00655

RETENTION AND RESUSPENSION OF PHOSPHORUS, NITROGEN, AND IRON IN A CENTRAL ONTARIO LAKE.
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
P. J. Dillon, R. D. Evans, and L. A. Molot.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1269-1274, July 1990. 2 fig, 2 tab, 44 ref.

Descriptors: *Limnology, *Nutrients, *Ontario, *Sediment transport, Comparison studies, Iron, Lakes, Mass balance methods, Nitrogen, Phosphorus, Sediment sampler, Suspended sediments.

Sediment traps were used to estimate the downward flux of total phosphorus, total Kjeldahl nitrogen, and iron in a small Precambrian shield lake for 4 yr. The flux as determined by the sediment trap method was much higher than the retention of the same elements as measured by mass balance methods (input-outflow). Total phosphorus (TP) sedimentation was about 17 times higher than retention while N was about 3 times higher and Fe was about 31 times higher. Very high N/P ratios in epilimnetic waters (36/1 by weight) and low N/P ratios in trap material (8/1) and surficial sediments (mean 8/1, range 4-11/1), in conjunction with high sedimentation to retention ratios, strongly suggest that resuspended sediment is a major component of trap material. Fe/TP ratios suggest that surficial sediment from shallow waters (<13 m) was the largest contributor to resuspended sediment. Large amounts of biologically available phosphorus originating with resuspended sediments may enter upper waters. The difference between N/P ratios in surficial sediments (4-11/1) and nutrients retained from mass balance calculations (50/1) is attributed to denitrification. (Author's abstract)
W91-00656

USE OF EXTANT POPULATIONS OF SCALED CHRYSOPHYTES FOR THE INFERENCE OF LAKEWATER PH.
Connecticut Coll., New London. Dept. of Botany.
For primary bibliographic entry see Field 5A.
W91-00658

PHYTOPLANKTON COMMUNITIES OF LAKES EXPERIMENTALLY ACIDIFIED WITH SULFURIC AND NITRIC ACIDS.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W91-00659

VARIATION IN LAKE WATER TEMPERATURE IN THE NANTICOKE REGION OF LONG POINT BAY, LAKE ERIE, DURING THE OPEN-WATER SEASON.
Ontario Hydro, Toronto. Research Div.
T. G. Dunstall, D. W. Lawler, R. Farooqui, and G. T. Haymes.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1427-1433, July 1990. 5 fig, 1 tab, 20 ref.

Descriptors: *Lake Erie, *Limnology, *Ontario, *Water temperature, Climates, Long Point Bay, Seasonal variation, Upwelling.

Lake water temperature on the north shore of Long Point Bay near Nanticoke (Lake Erie) over the years 1971-1983 varied considerably during the lake warming cycle. Upwellings, resulting in temperature drops of 5-10 C over a 2-3 day period, were common from mid-May to mid-August. Warmer surface waters returned within 6 days (usually 3 days) following summer upwellings. In spring, the recovery times were variable, but typically lasted longer, up to 25 days. Temperature fluctuations that exceeded 5 C but lasted less than 48 hr also were frequent during the lake warming cycle. The progressive deepening of the epilimnion to the 12-m depth of Long Point Bay and the associated increase in the heat content of the Bay resulted in a stable temperature regime by mid-August. Diurnal heating and cooling of surface waters, by as much as 4 C, was apparent under calm conditions. Mean April-November temperatures varied by more than 2 C, reflecting annual variation in atmospheric warming. (See also W91-00662) (Author's abstract)
W91-00661

INFLUENCE OF UPWELLINGS, STORMS, AND GENERATING STATION OPERATION ON WATER CHEMISTRY AND PLANKTON IN THE NANTICOKE REGION OF LONG POINT BAY, LAKE ERIE.
Ontario Hydro, Toronto. Research Div.
T. G. Dunstall, J. C. H. Carter, B. P. Monroe, G. T. Haymes, and R. R. Weiler.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1434-1445, July 1990. 8 fig, 4 tab, 28 ref.

Descriptors: *Electric powerplants, *Lake Erie, *Limnology, *Nutrients, *Ontario, *Storms, *Thermal pollution, *Upwelling, *Water pollution effects, Climates, Copepods, Long Point Bay, Seasonal variation, Water temperature, Zooplankton.

Storms and upwellings resulted in significant alterations to the aquatic environment in the Long Point Bay region of Lake Erie, contributing to short-term variability in water chemistry and plankton. Both storms and upwellings resulted in nutrient enrichment (filtered reactive phosphorus, total inorganic nitrogen, reactive silicates, and organic nitrogen) in lake surface waters during the period of lake warming, prior to mid-August. Storms and upwellings also differentially affected the distributions of specific zooplankton taxa in the lake surface stratum. The most prominent effect was the increased abundance of Diacyclops bicuspidatus thomasi during upwellings, particularly towards shore. The once-through cooling process of the generating station also affected zooplankton distributions, most notably that of D. bicuspidatus thomasi, which exhibited a nearshore increase in abundance that was similar to the influence exerted by upwelling. (See also W91-00661) (Author's abstract)
W91-00662

PHOSPHORUS AND NITROGEN LIMITATION OF PHYTOPLANKTON GROWTH IN THE FRESHWATERS OF NORTH AMERICA: A REVIEW AND CRITIQUE OF EXPERIMENTAL ENRICHMENTS.
California Univ., Davis. Div. of Environmental Studies.
J. J. Elser, E. R. Marzolf, and C. R. Goldman.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1468-1477, July 1990. 1 fig, 5 tab, 65 ref. NSF Grants BSR-8705170 and BSR-8801084.

Descriptors: *Eutrophication, *Limiting nutrients, *Limnology, *Nitrogen, *Nutrients, *Phosphorus, *Phytoplankton, Algal growth, Experimental design, Freshwater, Literature review, North America.

While phosphorus is generally considered to be the primary nutrient limiting algal growth in lakes, limitation of algal growth by nitrogen has been observed in freshwater. It also commonly observed that the most pronounced phytoplankton responses to enrichment occur when both N and P are added together. Nitrogen's status as a secondary nutrient in freshwater was re-evaluated through a systematic literature search. A survey of enrichment bioassays showed considerable differences in the degree to which investigators applied sufficient replication, performed and reported statistical tests, and assessed seasonal and spatial differences in algal nutrient limitation. Given these limitations, however, it was found that combined N+P enrichment enhanced algal growth much more frequently and more substantially than did addition of N or P singly. On average, the frequency and degree of algal response did not differ for P vs N enrichment. Review of whole-lake fertilizations led to the conclusion that the roles of N and P in constraining algal growth in the whole-lake scale have not been separated completely. However, examination of the distribution between treatments (+N, +P, +N and P) of lake-years in which substantial algal growth response occurred indicated that combined N and P enrichment was required to consistently produce substantial algal growth response. A more important role than has been recognized previously for N as a limiting nutrient in freshwaters is indicated. We suggest that greater attention should be given to both and P and N in the future. (Author's abstract)
W91-00664

CYANOBACTERIA IN FISH PONDS.
Laboratoire d'Ichtyologie Generale et Appliquee, Paris (France).
J. Sevrin-Reyssac, and M. Pletikosic.
Aquaculture AQCLAL, Vol. 88, No. 1, p 1-20, July 1990. 4 fig, 3 tab, 99 ref.

Descriptors: *Cyanobacteria, *Cyanophtya, *Eutrophication, *Fish ponds, *Water pollution prevention, Aeration, Algicides, Fisheries, Fishkill, Nutrients, Phytoplankton.

In many fish ponds, blue-green algae (cyanobacteria) constitute the greater part of the phytoplanktonic biomass during the summer. They sometimes form spectacular water blooms, often with harmful consequences such as massive mortality among the fish due to depletion of oxygen after the bloom collapses. Their specific properties render cyanobacteria better able than other phytoplankton to adapt to certain conditions usually encountered in fish-ponds: reduced light penetration, and nitrogen depletion in the upper layer. Cyanobacteria which are able to assimilate dissolved atmospheric nitrogen gain a selective advantage over competitors when combined nitrogen fails, and many of them are capable of vertical migration due to buoyancy regulation. Blue-green algae are of poor food value to zooplankton, their large size making them inaccessible to the filter-feeding entomostraca. The substances produced by many species of cyanobacteria are toxic to aquatic plants and animals. The algicides used to limit the development of cyanobacteria are effective but are often detrimental to the environment. Increasing the N:P ratio to 5 or more benefits chlorophyceae and reduces the number of cyanobacteria. Aerators break vertical stratification and increase concentrations of oxygen making water conditions unfavorable to blue-green algae. (Author's abstract)
W91-00665

LIMNOLOGICAL STUDIES OF FOUR POLLUTED PONDS IN AND AROUND DHAKA CITY WITH REFERENCE TO INDICATOR SPECIES.
Dacca Univ. (Bangladesh). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W91-00672

EFFECTS OF NUTRIENTS AND WATER LEVELS ON EMERGENT MACROPHYTE BIOMASS IN A PRAIRIE MARSH.
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
C. Neill.
Canadian Journal of Botany CJBOAW, Vol. 68, No. 5, p 1007-1014, May 1990. 2 fig, 5 tab, 40 ref.

Descriptors: *Emergent aquatic plants, *Fertilizers, *Limnology, *Macrophytes, *Marshes, *Nutrients, *Water level fluctuations, *Water pollution effects, *Wetlands, Biomass, Cattails, Marsh plants, Nitrogen, Phosphorus, Plant growth.

Nitrogen and phosphorus fertilizers were added over two growing seasons to marshes dominated by whitetop grass (Scolochloa festucacea) or cattail (Typha glauca) in a prairie lacustrine marsh to assess nutrient limitation and the interaction of nutrient limitation with water depth. For each species, stands were selected at the deep and shallow extremes of its water depth range. Water levels were high during the first year of fertilization and low during the second year, exposing the

fertilized stands to a variety of water depths. Nitrogen limited growth in whitetop and cattail marshes. Water level, by controlling whether the soil was flooded or the water table was below the soil surface, affected growth and the degree of nitrogen limitation. In whitetop marshes, nitrogen increased biomass more when the soil was flooded or when standing water was deeper and in cattail marshes, it increased biomass more under intermediate water depths (approximately 0-20 cm) than under more deeply flooded (20-40 cm) or dry conditions. Nitrogen reduced biomass in whitetop marshes the second year, apparently because growth was inhibited by fallen litter from the previous year. Nitrogen did not limit cattail marsh biomass in the driest locations during a year of low water levels. Phosphorus caused a small increase in growth of both species after 2 years. Changes of nitrogen limitation with flooding suggest that annual water level fluctuations, by creating alternating flooded and dry conditions, may influence the primary production of emergent macrophytes through effects on nitrogen cycling. (Author's abstract)
W91-00673

EFFECTS OF NUTRIENTS AND WATER LEVELS ON SPECIES COMPOSITION IN PRAIRIE WHITETOP (SCOLOCHLOA FESTUCACEA) MARSHES.
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
C. Neill.
Canadian Journal of Botany CJBOAW, Vol. 68, No. 5, p 1015-1020, May 1990. 4 tab, 32 ref.

Descriptors: *Grasses, *Limnology, *Marsh plants, *Nutrients, *Plant growth, *Species composition, *Water level fluctuations, *Wetlands, Biomass, Fertilizers, Nitrogen, Phosphorus, Water pollution effects.

Nitrogen and phosphorus fertilizers were added over two growing seasons to whitetop marshes growing at the shallow and deep extremes of whitetop's water depth range in a northern prairie marsh to assess the effects of nutrient additions and water levels on species composition and understory species biomass. Nitrogen and nitrogen plus phosphorus additions reduced understory species biomass and caused only small changes in marsh species composition after 1 yr, but dramatically decreased whitetop biomass and increased the biomass of the understory moist soil annual Atriplex patula at both water depths after 2 yr. Phosphorus alone had little effect on species composition. Water levels influenced both the biomass of understory species and their potential response to nutrient additions. Biomass of understory species during both years was lower in deeper water. Nutrients had no effect on understory species biomass when standing water was present because standing water prevented seed germination. A mulching effect caused by greater whitetop litter accumulation and weaker whitetop stems associated with nitrogen fertilization appeared to be more important influences on understory species composition than differential understory species growth responses to added nutrients. Predicting responses of whitetop marshes to multiyear fertilization requires an understanding of the interactions between the physical conditions caused by increased biomass of whitetop, the relative abilities of understory moist soil species to grow under those conditions, and water levels, which control understory species seed germination and plant survival. (Author's abstract)
W91-00674

ECOLOGICAL STUDIES ON THE PLANKTON AND BENTHOS OF WADI ELRAYAN, A NEW LAKE IN EGYPT.
Ain Shams Univ., Cairo (Egypt). Faculty of Science.
I. A. Aboul-Ela, and M. T. Khalil.
Tropical Freshwater Biology, Vol. 2, No. 1, p 101-111, 1989. 1 fig, 6 tab, 20 ref.

Descriptors: *Benthos, *Egypt, *Lakes, *Limnology, *Zooplankton, Colonization, Phytoplankton, Species composition, Species diversity, Succession.

Production of plankton and benthos were investigated for the first time in a new Egyptian lake, Wadi Elrayan, during the period June 1979 to June 1980. The average abundance of phytoplankton in the lake was estimated at about 519,000 cells/L. The seasonal mean primary production estimated at 12.4 gm O2/sq m/day is closer to the maximum levels recorded for other African freshwater lakes. Zooplankton and benthic communities have not yet reached a level of stability comparable to that of phytoplankton. The seasonal mean abundance of zooplankton is about 12,500 organisms cu m while that of macrobenthos is about 1200 organisms/sq m. The lake is still in its developing stages. (Author's abstract)
W91-00679

LITTORAL BENTHIC FAUNA OF LAKE MANAGUA, NICARAGUA: A STUDY COMPARING ARTIFICIAL AND NATURAL SUBSTRATA.
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
L. Bijlmakers, and A. E. Sobalvarro.
Tropical Freshwater Biology, Vol. 2, No. 1, p 121-129, 1989. 3 fig, 2 tab, 15 ref.

Descriptors: *Invertebrates, *Lakes, *Limnology, *Littoral zone, *Nicaragua, *Sampling, Colonization, Quantitative analysis, Species composition.

An attempt was made to standardize the sampling of littoral invertebrate fauna of a lake by use of artificial substrata. Baskets of stones were placed in the littoral zone of Lake Managua, Nicaragua, at different locations. Monthly samples at the same location did not show distinct differences in faunal composition or relative abundance. On the other hand, between location differences were found in faunal composition as well as relative abundance. The fauna found on natural substrates and artificial substrata was shown to be very similar. This provides the opportunity to characterize the invertebrate fauna of the different locations quantitatively by means of artificial substrata. (Author's abstract)
W91-00681

ECOLOGY OF CYCLOPOID COPEPODS (COPEPODA: CRUSTACEA) IN A TROPICAL BACKWATER POND.
Benin Univ., Benin City (Nigeria). Dept. of Zoology.
R. Victor, and A. S. Mathews.
Tropical Freshwater Biology, Vol. 2, No. 1, p 130-140, 1989. 5 fig, 40 ref.

Descriptors: *Copepods, *Crustaceans, *Limnology, *Ponds, *Population dynamics, *Tropical regions, Benthos, Ecology, Nigeria, Pesticides, Species composition, Species diversity, Water pollution effects.

Some aspects of the ecology of cyclopoid copepods were studied in a backwater pond in Southern Nigeria. Five species, Mesocyclops salinus, Thermocyclops crassus, Tropocyclops prasinus, Eucyclops serrulatus and Ectocyclops c.f. ilariensis were recorded. M. salinus and T. crassus, the abundant species, were distributed both in water column and in benthos; the relative abundance of other species, found only in the water column were low. The dominant species in this pond at any one time was either M. salinus or T. crassus depending on the season; M. salinus was dominant during the dry season, while T. crassus was dominant during the wet season. Monthly fluctuations in actual abundance showed two peaks each for M. salinus and T. crassus; the abundance patterns of these two species in water column and in benthos were similar. The peak abundance of M. salinus occurred earlier in benthos than in water column. The major peak of abundance for T. crassus occurred both in water column and in benthos at the same time, while the minor peak was recorded earlier in benthos than in water column. M. salinus was more resistant to pesticide treatment than other species; all species were capable of rapid recolonization. (Author's abstract)
W91-00682

ESTIMATION OF THE CRITICAL OXYGEN TENSION FOR AND RECOVERING CAPABILITIES OF RED TILAPIA (OREOCHROMIS NILOTICUS X OREOCHROMIS MOSSAMBICUS) HYBRIDS.
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. of Animal Production in the Tropics and Subtropics.
K. Becker, D. Noffz, and L. Fishelson.
Tropical Freshwater Biology, Vol. 2, No. 1, p 141-148, 1989. 1 fig, 2 tab, 14 ref.

Descriptors: *Oxygen requirements, *Oxygen uptake, *Respiration, *Tilapia, Adaptation, Fisheries, Oxygen demand.

Studies were carried out to determine the level of independency of oxygen consumption in Oreochromis niloticus X Oreochromis mossambicus hybrids from the oxygen pressure (PO2) of water in a closed recirculating system. Mean critical oxygen tension (Pc) was 65.1 + or -13.4 millibars, varying from 45.1 to 73.8 among the four individuals tested. Standard metabolic rate (SMR) and routine metabolic rate (RMR) were 101.6 + or -20.2 and 113.7 + or -20.1 milligrams O2/0.8 kg/hr, respectively. When Pc had been reached, oxygen consumption (VO2) values remained stable for some time before falling, indicating some adaptation mechanism not revealed when measurements were made in static sealed systems. Complete recovery under experimental conditions was reached after 12 to 18 hr. (Author's abstract)
W91-00683

VEGETATIVE GROWTH OF SPIRODELA POLYRRHIZA AS AFFECTED BY MEDIUM CONCENTRATION, DAYLIGHT INTENSITY AND AGE.
Benin Univ., Benin City (Nigeria). Dept. of Botany.
J. M. O. Eze, and J. E. Dolor.
Tropical Freshwater Biology, Vol. 2, No. 1, p 149-157, 1989. 3 fig, 14 ref.

Descriptors: *Aquatic weed control, *Drinking water, *Duckweed, *Eutrophication, *Growth media, *Light intensity, *Plant growth, Catchment areas, Chlorophyll, Developing countries, Nigeria, Nutrients, Water supply.

The vegetative growth of the duckweed, Spirodela polyrrhiza (Linn.) Schleid in 100 ml glass beakers containing water culture medium of different concentrations was measured under various daylight intensities (0-100% daylight intensity). The basal nutrient medium supported maximum root development, but the best overall growth in terms of fresh or dry weight and total number of thalli was obtained in half the strength of the basal medium. Increasing the nutrient medium concentration beyond half the basal strength generally led to progressive reduction in growth. Increase in daylight intensity resulted in increase in total fresh or dry weight, number, surface area, root length and chlorophyll contents of the thalli. High light intensity increased the rate of budding at the expense of dry weight accumulation in the individual thalli. In all media, the productivity of individual thalli as represented by rate of multiplication diminished with the increase in age. These findings may be relevant to preventing duckweed growth in reservoirs in Nigeria and other developing countries that store drinking water in catchment areas, and in duckweed eutrophication prevention in local natural habitats. (Author's abstract)
W91-00684

WATERBIRDS DYNAMICS AT BOOL LAGOON, SOUTH AUSTRALIA, 1983-87.
Australian National Parks and Wildlife Service, Berri.
M. J. Harper.
Australian Wildlife Research AWLRAO, Vol. 17, No. 2, p 113-122, 1990. 7 fig, 2 tab, 11 ref.

Descriptors: *Australia, *Bool Lagoon, *Limnology, *Population dynamics, *Water birds, Rainfall, Seasonal variation, Water depth, Wetlands.

Monthly waterbird counts from July 1983 to June 1987 at Bool Lagoon Game Reserve and Hacks Lagoon Conservation Park in the southeast of South Australia were used to investigate relationships between the numbers of each species, and season, water depth and rainfall. Numbers of little black cormorant, great crested grebe, sacred ibis, straw-necked ibis and whiskered tern were most influenced by season. Little pied cormorant, royal spoonbill, musk duck, white-faced heron, yellow-billed spoonbill, black swan, brolga, masked lapwing and silver gull numbers were associated with variation in water level of the lagoon. Pacific black duck numbers were inversely related to lagoon levels and local rainfall, while numbers of Australian shelduck varied inversely with local rainfall. Numbers of most waterbirds were highest at the Bool Lagoon complex in either spring or early autumn, indicating the importance of this wetland as a breeding site and dry season refuge respectively. (See also W91-00687) (Author's abstract)
W91-00686

LEAD POISONING IN MAGPIE GEESE ANSERANUS SEMIPALMATA FROM INGESTED LEAD PELLET AT BOOL LAGOON GAME RESERVE (SOUTH AUSTRALIA).
Australian National Parks and Wildlife Service, Berri.
For primary bibliographic entry see Field 5C.
W91-00687

MAGPIE GOOSE, ANSERANUS SEMIPALMATA, NESTING ON THE MARY RIVER FLOODPLAIN, NORTHERN TERRITORY, AUSTRALIA: EXTENT AND FREQUENCY OF FLOODING LOSSES.
Conservation Commission of the Northern Territory, Darwin (Australia).
P. J. Whitehead, and K. Tschirner.
Australian Wildlife Research AWLRAO, Vol. 17, No. 2, p 147-157, 1990. 5 fig, 3 tab, 16 ref.

Descriptors: *Australia, *Flooding, *Geese, *Population dynamics, *Water birds, *Water depth, Rainfall, Seasonal variation.

Magpie geese, Anseranus semipalmata, nest synchronously in large colonies on the seasonally inundated floodplains of the Northern Territory. Erratically variable wet season rainfalls may cause rises in floodplain water levels that destroy many nests. An event is described on the Mary Plain floodplain in which all of the nests within a monitored study area were drowned. Vulnerability to flooding (as indicated by variation in depth at which eggs first submerged) varied significantly among vegetation types. Mean rises in water levels causing inundation of eggs varied from 67 cm in nests constructed on a base of Oryza rufipogon to 118 cm on nests constructed on Eleocharis brassii. Nests close to major river channels are more vulnerable to flooding. Analysis of patterns of river level rises since 1959 indicate that such catastrophic nest losses are relatively common, perhaps occurring as often as one year in seven. Lesser flooding losses probably occur in most years. Nesting colonies on the Mary River are likely to suffer higher flooding mortalities than on many other river systems. (Author's abstract)
W91-00688

PIGMENT STRATIGRAPHY AND TROPHIC STATUS: AN EVALUATION OF RADIONUCLIDE-DATED LACUSTRINE SEDIMENT.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
C. L. M. Steenbergen, G. W. Berger, H. J. Korthals, and H. Verdouw.
Geomicrobiology Journal GEJODG, Vol. 7, No. 4, p 207-222, 1989. 5 fig, 2 tab, 44 ref.

Descriptors: *Lacustrine environment, *Limnology, *Pigments, *Radionuclides, *Stratigraphy, Carotenoids, Cesium radioisotopes, Chlorophyll, Eutrophication, Lake Vechten, Lead radioisotopes, Pheophytins, Sediment chemistry, Sedimentation, The Netherlands.

Sediment cores from the profundal region of relatively young (circa 45 years), warm-monomictic Lake Vechten were dated with cesium-137 and lead-210 and analyzed for major carotenoids, chlorophyll, and pheophytin. Vertical sediment accretion rates determined from clay/sand horizon and from the radionuclide datings varied between 0.60 and 0.74 cm/year. Sedimentation rates based on particulate matter collected in sediment traps agreed with results of the cesium-137 method with average values of respectively 2.9 and 2.3 kg dry weight/sq m/year. The profundal sediment appears to be fairly undisturbed. Pigments showed a severalfold increase from the deepest to the superficial sediment layers. The sediment profiles were compared with limnological data obtained during previous studies of Lake Vechten. The distribution of pigments reflected clearly the trophic history of the lake, which became more eutrophic during the last two decades. Pigment analyses of sediment cores may be a useful tool to rapidly obtain rough basic information on the recent trophic development of stratified lakes liable to eutrophication. (Author's abstract)
W91-00692

EFFECTS OF INVERTEBRATE PREDATION ON THE SEASONAL SUCCESSION OF A ZOOPLANKTON COMMUNITY: A TWO YEAR STUDY IN LAKE AYDAT, FRANCE.
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. d'Hydrobiologie.
N. Lair.
Hydrobiologia HYDRB8, Vol. 198, p 1-12, July 30, 1990. 10 fig, 1 tab, 85 ref.

Descriptors: *France, *Invertebrates, *Lake Aydat, *Limnology, *Predation, *Seasonal variation, *Spatial distribution, *Succession, *Temporal distribution, *Zooplankton, Ciliates, Midges, Population dynamics, Rotifers.

Direct observations on living animals, examination of gut contents, spatio-temporal distribution analysis, demographic data and a two year comparative study of zooplankton population dynamics illustrate the importance of invertebrate predation on the seasonal succession of the zooplankton in Lake Aydat, Central Massif, France. Three invertebrate predators living in this eutrophic lake contribute to regulate the populations' development. The rotifer Asplanchna priodonta exerts a predation pressure on Keratella cochlearis, Polyarthra remata and Polyarthra dolichoptera. The copepod Cyclops vicinus vicinus exerts a predation pressure on the latter two rotifer species. The larvae of the dipteran Chaoborus cristallinus consumes Asplanchna priodonta, Kellicottia longispina, Bosmina longirostris, Daphnia longispina, Ceriodaphnia quadrangula and ovigerous females of Cyclops vicinus vicinus. Adults of Acanthodiaptomus denticornis, which consume large ciliates in this lake, may contribute to the rotifer decline at the end of the summer. The interactions between invertebrate predators and their preys are reflected in quantitative changes in community dynamics. (Author's abstract)
W91-00694

PREDATION ON AND BY PELAGIC TURBELLARIA IN SOME LAKES IN BRAZIL.
Universidade Federal de Sao Carlos (Brazil). Lab. of Limnology.
O. Rocha, T. Matsumura-Tundisi, J. G. Tundisi, and C. P. Fonseca.
Hydrobiologia HYDRB8, Vol. 198, p 91-101, July 30, 1990. 5 fig, 9 tab, 21 ref.

Descriptors: *Animal behavior, *Ecosystems, *Lakes, *Limnology, *Platyhelminthes, *Predation, Brazil, Population dynamics, Zooplankton.

Planktonic Turbellaria commonly occur in both natural and manmade lakes in Brazil. Experiments were performed in 1987 and 1989 to determine which zooplankton species are consumed by predatory Mesostoma sp. from three natural lakes in the Rio Doce Valley. Experiments were also performed in 1989 with a yet unidentified flatworm from Barra Bonita reservoir. Both predators consumed Daphnia and Ceriodaphnia at a high rate: four individuals per day in the case of Mesostoma sp., a large species, and 1.5 individuals per day in the case of the smaller species from the Barra Bonita reservoir. Consumption of copepod naupliii, copepodids, and adults was much lower, and Ostracoda were not consumed at all. Experiments on food selectivity showed a clear preference by the flatworms for cladocerans. In the lakes studied, flatworms are heavily preyed upon by larvae of Chaoborus and Mesocyclops species. Turbellaria densities in the natural lake were around three hundred per cubic meter, whereas in Barra Bonita reservoir, one thousand individuals per cubic meter was a mean value in a fifteen-day study. (Author's abstract)
W91-00695

CYCLOMORPHOSIS IN DAPHNIA: AN ADAPTATION TO AVOID INVERTEBRATE PREDATION.
Warsaw Univ. (Poland). Dept. of Hydrobiology.
J. Pijanowska.
Hydrobiologia HYDRB8, Vol. 198, p 41-50, July 30, 1990. 9 fig, 1 tab, 16 ref.

Descriptors: *Animal physiology, *Daphnia, *Ecosystems, *Invertebrates, *Lakes, *Limnology, *Predation, Allometry, Morphology, Seasonal variation.

Seasonal morphological changes in three Daphnia species were followed over a two-year period in two lakes that differ in invertebrate and fish pressure. Whereas the morphology of Daphnia hyalina, the biggest of the three species, varied little from season to season, Daphnia cucullata, the smallest, exhibited the most pronounced seasonal changes in head height/carapace length ratio. The pattern of seasonal changes of body proportions was similar in all size classes and isometric growth of the head was reported for Daphnia cucullata. Unlike the head, tail spine length/carapace length ratio almost did not vary seasonally. Strong negative allometry of tail spine growth was observed. These results are consistent with the hypothesis that helmets and tail spines provide protection against invertebrates in the two smallest, thus most endangered species. (Author's abstract)
W91-00696

CREATING CONDITIONS FOR CHANGES IN PREY COMMUNITY STRUCTURE BY CHAOBORUS SPP. IN A LAKE IN SWEDEN.
Goeteborg Univ. (Sweden). Dept. of Zoology.
J. A. E. Stenson.
Hydrobiologia HYDRB8, Vol. 198, p 205-214, July 30, 1990. 7 fig, 5 tab, 32 ref.

Descriptors: *Acid lakes, *Lake restoration, *Lakes, *Liming, *Population dynamics, *Predation, *Species composition, *Sweden, Cladocerans, Copepods, Lake Gardsjon, Rotifers, Zooplankton.

In Lake Gardsjon (Southwest Sweden), liming as an experimental improvement of living conditions for pelagic algae, resulted in a significant increase of algal biomass and a reduction of mean cell size. The algal development was beneficial for small sized filter feeding zooplankton, particularly rotifers, which showed a significant increase. The increase in abundance of small sized zooplankton created better food conditions for the smaller instars, and thus a much better overall survival of Chaoborus larvae. The resulting, six to seven times larger population of Chaoborus larvae significantly changed the structure of the crustacean zooplankton community. Bosmina coregoni populations were strongly reduced by the increased predation from Chaoborus. The share of cladocerans decreased, while copepods increased in abundance. (Author's abstract)
W91-00697

BENTHIC TURFS VS FLOATING MATS OF ALGAE IN RIVER FOOD WEBS.
California Univ., Berkeley. Dept. of Zoology.
M. E. Power.
OIKOS OIKSAA, Vol. 58, No. 1, p 67-79, May 1990. 8 fig, 3 tab, 56 ref. NSF grant RII-8600411, California State Water Resources Center Grant W-726.

Descriptors: *Algae, *Ecosystems, *Midges, *River systems, Algal growth, Food chains, Invertebrates.

In the Eel River of northern California, as in many other sunlit rivers worldwide, large growths of filamentous green algae accumulate during summer low flow periods. Algae initially grow as turfs, attached to the river bed, but over time detach to form floating mats. Floating mats differ from attached turfs as habitats for invertebrates in a number of respects. In paired trials, larval chironomids were 15 to 16 times more likely to be consumed by fishes when exposed in algal turfs on the river bed than when exposed in floating algal mats on the river surface. On average, 2.7 and 6.1 times more adult insects emerged from floating mats than from benthic algal turfs in shallow (< 30 cm deep) and deep (30 to 60 cm deep) habitats, respectively. Differences between algal mats and turf as cover and habitat for resident insects lead to the hypothesis that the timing, abundance and duration of floating mat habitats strongly influences the routing of insect production in river food webs, to aquatic consumers or to the land. (Author's abstract)
W91-00708

RESISTANCE OF LOTIC ECOSYSTEMS TO A LIGHT ELIMINATION DISTURBANCE: A LABORATORY STREAM STUDY.
Oak Ridge National Lab., TN. Environmental Sciences Div.
A. D. Steinman, P. J. Mulholland, A. V. Palumbo, T. F. Flum, and J. W. Elwood.
OIKOS OIKSAA, Vol. 58, No. 1, p 80-90, May 1990. 5 fig, 4 tab, 52 ref. DOE Contract DE-AC05-840R21400, Interagency Agreement 40-689-78 with NSF Ecosystems Studies Programs.

Descriptors: *Aquatic ecosystems, *Light intensity, *Species diversity, *Streams, Biomass, Grazing, Nutrient concentrations.

Black plastic was placed over eight laboratory stream channels for 92 days to examine the resistance of lotic ecosystems to light elimination. Prior to the disturbance, four treatments (high grazing-recirculated flow, high grazing-once-through flow, low grazing-recirculated flow, low grazing-once-through flow) were imposed on the streams, resulting in systems with different biomass levels and recycling indices. Light elimination resulted in significant declines of all functional and most structural properties associated with the streams, irrespective of treatment. Declines in species diversity and number were greater in high grazed than low grazed streams. However, high grazed streams appeared more resistant than low grazed streams with respect to autotrophic biomass and carbon fixation. Nutrient levels had little influence on resistance. The relatively small effect of the treatments on system resistance may be more dependent on the qualities of the disturbance (e.g. magnitude and duration) than those of the system. (Author's abstract)
W91-00709

MONTHLY VARIATIONS IN ENTROPY PRODUCTION IN LAKE BIWA.
Osaka Univ. (Japan). Dept. of Physics.
I. Aoki.
Ecological Modelling ECMODT, Vol. 51, No. 3/4, p 227-232, June 1990. 2 fig, 1 tab, 14 ref.

Descriptors: *Energy transfer, *Entropy, *Japan, *Limnology, *Thermodynamics, Comparison studies, Ecology, Energy, Eutrophication, Lake Biwa, Lake Mendota, Succession, Trophic level.

Monthly entropy fluxes in the northern basin of Lake Biwa (Japan) were calculated from corresponding energy data for the lake. That is, the lake absorbs 'negative entropy' from its surroundings according to the terminology of Schrodinger: the lake is structured by its surroundings. From the net entropy flow and the change of entropy content, entropy production in the lake was estimated. Entropy production, which is positive in all months, is larger in summer and smaller in winter. The monthly entropy production (Sprod in units of MJ/cu m/K) increases linearly with the monthly solar radiation energy absorbed by the lake (Esolar in units of MJ/sq m/mo); Sprod = a + b Esolar, where a = 0.002 (MJ/cu m/mo/K)), b = 0.000060 (per m/K). The values a and b are holistic indices characterizing the lake from an entropy point of view. Another index (b'), which is similar to b also is introduced. Comparison of these indices for the northern basin of Lake Biwa (oligotrophic) with those for Lake Mendota (Wisconsin, USA, eutrophic) shows that process of eutrophication or succession are accompanied by the increase of these entropy production indices. (Author's abstract)
W91-00717

BACTERIAL REGENERATION OF AMMONIUM AND PHOSPHATE AS AFFECTED BY THE CARBON:NITROGEN:PHOSPHORUS RATIO OF ORGANIC SUBSTRATES.
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
For primary bibliographic entry see Field 5B.
W91-00732

SEASONAL CHANGES OF THE ENVIRONMENTAL CONDITIONS IN DIMICTIC LAKES DIFFERING AS TO THEIR TROPHIC STATE (SEZONOWE ZMIANY WARUNKOW SRODOWISKA W JEZIORACH DYMIKTYCZNYCH O ROZNYM STOPNIU EUTROFIZACJI).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
S. Prusik, B. Zdanowski, and A. Hutorowicz.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 2, p 41-75, 1990. 11 fig, 3 tab, 27 ref. English summary.

Descriptors: *Dissolved oxygen, *Lakes, *Limnology, *Poland, *Trophic level, *Water temperature, Ammonia, Aquatic habitats, Chlorophyll, Cycling nutrients, Mazurian Lake District, Mixing, Phosphates, Phosphorus, Seasonal variation, Stratification, Transparency.

Studies were carried out in 1982 on the seasonal variations in thermal and oxygen conditions, nutrient cycling, Secchi disk visibility, and chlorophyll content of eight dimictic lakes of the Mazurian Lake District. Lake trophy corresponded with susceptibility to degrading factors as indicated by Ohle's and Schindler's indices and by the annual levels of lake loading with phosphorus. Along with increasing trophy, content of basic nutrients increased as did the electrical conductivity of the water. Seasonal variations in oxygen conditions were the primary factor differentiating the environmental conditions of the lakes. Changes of oxygen content in the epilimnion and below this water layer were related strictly to lake trophy. The least variation in oxygen levels in the epilimnion was observed in the least oligotrophic lakes. Several indices estimate the trophic status of the lakes: seasonal variations in epilimnial oxygen content; rate of oxygen deficit formation in the near-bottom water layers, hypolimnion, and metalimnion; stratification of the oxygen content in the water column and the shape of the vertical oxygen profile; Secchi disk visibility and chlorophyll content in summer; amplitude of variations in the chlorophyll content in summer; P and N content in the epilimnion in spring and summer; nitrate content in spring; rate of liberation of phosphates and ammonia from bottom sediments and accumulation of these compounds in the hypolimnion and epilimnion after stratification; absolute content of total phosphorus, phosphates, and ammonia in the near-bottom water layers at the peak of summer stagnation; content of calcium and carbonates and electrical conductivity of the water; and intensity of accumulation of mineral salts in the hypolimnion and the range of the seasonal variations in amount of calcium, carbonates, and electrical conductivity between spring and summer and between the epilimnion and hypolimnion. (Rochester-PTT)
W91-00735

SEDIMENT-WATER INTERACTION AS A CONTROL ON GEOCHEMICAL EVOLUTION OF PLAYA LAKE SYSTEMS IN THE AUSTRALIAN ARID INTERIOR.
Queensland Univ. of Technology, Brisbane (Australia). Dept. of Applied Geology.
A. V. Arakel, G. Jacobson, and W. B. Lyons.
Hydrobiologia HYDRB8, Vol. 197, p 1-12, May 31, 1990. 7 fig, 28 ref.

Descriptors: *Australia, *Geochemistry, *Lakes, *Limnology, *Playas, *Saline lakes, *Sediment-water interfaces, *Water chemistry, Aquifers, Basins, Carbonates, Catchment areas, Evaporation, Evolution, Groundwater, Hydrology, Minerals, Sediments, Silica, Silicates.

Saline playa lakes represent major geomorphic and hydrologic components of internal drainage basins in the arid to semiarid interior of Australia. These lakes mark the outcrop areas of regional shallow groundwater; thus, they are effective hydro-chemical sinks for elemental concentration and authigenic formation of carbonate, evaporite, and silica/silicate minerals. Field observations and petrochemical characterization of playa sediments from drainage basins in Western and Central Australia indicate that localized discharge of groundwater, from shallow aquifers in calcrete deposits, plays a fundamental role in geochemical evolution of playa-lake marginal facies. The available data also indicate that although evaporative concentration and salt recycling are major controls on geochemistry of the playas, a simple evaporative model does not provide a complete explanation for brine evolution and particularly the geochemical process-product relationships observed in the individual playa lakes. The distribution of the chemical facies in the playas, in relation to geomorphic setting of the internal drainage basins, reflects a significant impact of variation in groundwater discharge pattern on geochemical evolution of the playa lakes. Accordingly, the development of chemical facies in individual playas have progressed through repeated episodes of evaporative concentration, groundwater-level fluctuations and ion-exchange processes. (Author's abstract)
W91-00736

METAL CONCENTRATIONS IN SURFICIAL SEDIMENTS FROM HYPERSALINE LAKES, AUSTRALIA.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
For primary bibliographic entry see Field 2K.
W91-00737

HEAVY METALS IN THE DEAD SEA AND THEIR COPRECIPITATION WITH HALITE.
Weizmann Inst. of Science, Rehovoth (Israel).
M. Stiller, and L. Sigg.
Hydrobiologia HYDRB8, Vol. 197, p 23-33, May 31, 1990. 1 fig, 4 tab, 21 ref.

Descriptors: *Chemical precipitation, *Dead Sea, *Geochemistry, *Halite, *Heavy metals, *Lakes, *Limnology, *Metals, *Saline lakes, *Salts, *Water chemistry, Analytical techniques, Anodic stripping voltammetry, Hydrochemistry, Meromictic lakes, Sediments, Stratification, Voltammetry.

After a prolonged period of stratification (about 300 years) the Dead Sea overturned in 1979 and again in 1982. Its waters became saturated with respect to halite and the massive precipitation which occurred in winter 1982/1983 was monitored. The fate of the heavy metals was followed during this period of physical and chemical changes. The concentrations of Zn, Cd, Pb and Cu in the Dead Sea waters were measured by anodic stripping voltammetry (ASV) which provided sensitive measurement of these elements after a minimal pretreatment of the samples (dilution 1:1 and acidification). In the meromictic lake (prior to 1979), the concentrations of all four elements were larger in the deep anoxic layers. With the onset of halite precipitation a decline in their concentrations was observed. Most dramatic was the decrease in Cd, which practically disappeared from the water column in 1985. The coprecipitation of heavy metals with halite (collected by sediment traps in 1983) was examined, as well as that of older halite recovered from a sediment core. Although concentrations of heavy metals were some-

what larger in recent halite, all halite samples had the same concentration pattern: the concentration of Pb was the largest, followed by Cd, and Cu was the smallest. The apparent distribution coefficient was larger for Cd than for Pb. The amount of Cd which may have accompanied the deposition of halite during 1983-85 was estimated. It is compatible with its observed disappearance from the water column in 1985. The amounts of Zn and Pb which are missing from the Dead Sea of 1985 are much larger than can be accounted for by coprecipitation with halite. A possible explanation is that the formation of halite crystals may have enhanced settling of particulates which in turn may have scavenged Pb and Zn from the Dead Sea waters. Cu seems to be much less affected by the physical and chemical events which occurred in the Dead Sea waters during 1976-1985. (Author's abstract)
W91-00738

EVOLUTION OF SALINE LAKE WATERS: GRADUAL AND RAPID BIOGEOCHEMICAL PATHWAYS IN THE BASOTU LAKE DISTRICT, TANZANIA.
Michigan Univ., Ann Arbor. Dept. of Biology.
P. Kilham, and P. L. Cloke.
Hydrobiologia HYDRB8, Vol. 197, p 35-50, May 31, 1990. 10 fig, 3 tab, 50 ref. NSF Grants GB-8328X and OCE81-17377.

Descriptors: *Basotu Lakes, *Biochemistry, *Geochemistry, *Lakes, *Limnology, *Saline lakes, *Tanzania, *Water chemistry, Calcite, Calcium, Chemical properties, Closed lakes, Evolution, Illite, Minerals, Solutes, Sulfates.

The biogeochemical evolution of solutes markedly alters the chemistry in the closed-basin maar lakes that comprise the Basotu Lake District (Tanzania, East Africa). Examination of 11 (out of 13) lakes in the Basotu Lake District identified two distinct evolutionary pathways: a gradual path and a rapid path. During the course of biogeochemical evolution these waters follow either the gradual path alone or a combination of the gradual and rapid paths. Solute evolution along the gradual path is determined by all of the biogeochemical processes that for these waters appear to be tightly coupled to evaporative concentration (e.g. mineral precipitation, sorption and ion exchange, CO2 degassing, and sulfate reduction). Rapid evolution occurs when mixing events suddenly permit H2S to be lost to the atmosphere. The chemistry of waters undergoing rapid evolution is changed abruptly because loss of every equivalent of sulfide produces an equivalent permanent alkalinity. The Basotu Lake District in north central Tanzania is comprised of 13 maar lakes. They range in surface water conductivity from 592 to 24,000 micro S/cm (at 20 C). Within these lake basins only a few of the variety of geochemical and biogeochemical processes known to occur in lakes of this type are actually responsible for the gain and/or loss of individual solutes. For example, potassium appears to be taken up in the formation of illite. Calcium is precipitated as calcite. Magnesium interacts with alumino-silicate precursors to form a variety of clay minerals that contain magnesium (e.g. stevensite). This process is also known as reverse weathering. Sulfate is reduced to sulfide and subsequently lost as H2S and/or metal sulfides. Alkalinity is lost owing to calcite precipitation and as a consequence of reverse weathering. (Author's abstract)
W91-00739

HYDROGEOCHEMISTRY OF LAKE GALLOCANTA (ARAGON, NE SPAIN).
Barcelona Univ. (Spain). Dept. de Ecologia.
F. A. Comin, R. Julia, M. P. Comin, and F. Plana.
Hydrobiologia HYDRB8, Vol. 197, p 51-66, May 31, 1990. 10 fig, 4 tab, 23 ref. CAYCIT-CSIC (IO851).

Descriptors: *Geochemistry, *Geohydrology, *Hydrogeochemistry, *Lake Gallocanta, *Lakes, *Limnology, *Saline lakes, *Spain, *Water chemistry, Chemical precipitation, Dissolved solids, Interstitial water, Ions, Minerals, Salts, Seasonal variation, Sediment analysis.

Lake Gallocanta has undergone drastic changes during the last thirteen years. Variations in the major dissolved ions were related to water volume fluctuations from data at two different stages, one corresponding to the drying phase and another to the refilling phase. Mineralogical composition of the salts precipitated at different stages was examined by X-ray diffraction. Interstitial water and mineralogical composition of recent sediments were also studied along a transect through the lake. The water column decrease form 1977 to 1985 is related to decreasing annual rainfall. The refilling in 1986 to 1988 is due to high annual rainfall. In addition to these fluctuations, seasonal changes of the water level between 20 and 50 cm occurred every year. Gallocanta is a Na-Mg-Cl-(SO4) type lake. During the drying period a typical salt enrichment occurs with linear relationships between total dissolved solids, Cl, Na and K. Alkalinity is linearly correlated with Ca at relatively low salinities. As salinity increases a linear relationship between Ca and SO4 is observed. Minerals formed from the brine are halite, bischofite, epsomite, hexahydrite, mirabilite, gypsum, aragonite, calcite and dolomite. The molar ratio Mg/Ca of the interstitial water changes from 1.5 along the shorelines, where calcite and aragonite precipitate, to 40 in the center of the lake. Sediment cores from the central part of the lake show aragonite in the top layers, magnesium calcite and low proportions of quartz and illite, while at 20 cm depth a high proportion of gypsum is present. In contrast, cores from the shore of the lake are mainly composed of low magnesium calcite in the top layers and low magnesium calcite together with high magnesium calcite and dolomite between 30 and 70 cm depth. Gypsum deposits only occur in significant proportions at 80-100 cm depth. The refilling process showed relationships between volume and salt concentration following the Langbein model. The salt mass in solution decreased about 50% from the drying to the refilling phase. Mg content decreased about 70% for the same period. (Author's abstract)
W91-00740

RECENT CARBONATE SEDIMENTATION AND BRINE EVOLUTION IN THE SALINE LAKE BASINS OF THE CARIBOO PLATEAU, BRITISH COLUMBIA, CANADA.
Saskatchewan Univ., Saskatoon. Dept. of Geological Sciences.
R. W. Renaut.
Hydrobiologia HYDRB8, Vol. 197, p 67-81, May 31, 1990. 6 fig, 1 tab, 43 ref.

Descriptors: *Brines, *British Columbia, *Canada, *Carbonates, *Geochemistry, *Lakes, *Limnology, *Saline lakes, *Sedimentation, *Water chemistry, Cariboo Plateau, Closed lakes, Ephemeral lakes, Evolution, Lake basins, Minerals, Plateaus, Playas, Runoff, Salts, Sediments.

There are more than 100 closed, saline lakes in the semiarid, intermontane plateaus of British Columbia. They range from shallow perennial lakes to ephemeral playas. Most are groundwater-fed and lie within glaciofluvial deposits and till. Some have permanent salts. Where underlain by basalts, sodium carbonate brines predominate. Magnesium sulfate brines occur where catchments lie within Paleozoic sedimentary rocks, metasediments and basic volcanics. A few sodium sulfate brines are also present. A reconnaissance study of the sediments and mineralogy of 21 lake basins has shown that carbonates, including extensive magnesite and hydromagnesite deposits, and several occurrences of protodolomite, are widely precipitated in lake basins of each brine type. Analyses of stream, spring, ground and lake waters from the Cariboo Plateau region demonstrate that carbonate precipitation probably constitutes the major chemical divide responsible for producing the two dominant types of brine. (Author's abstract)
W91-00741

NUTRIENTS IN PORE WATERS FROM DEAD SEA SEDIMENTS.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
A. Nissenbaum, M. Stiller, and A. Nishri.
Hydrobiologia HYDRB8, Vol. 197, p 83-89, May 31, 1990. 2 fig, 4 tab, 14 ref.

Descriptors: *Dead Sea, *Interstitial water, *Lakes, *Limnology, *Nutrients, *Saline lakes, *Sediments, Ammonia, Carbonates, Chemical properties, Organic matter, Phosphates, Phosphorus removal, Sediment analysis, Sediment-water interfaces, Sinks, Sulfates.

Pore waters were separated from 50 cm-long cores of Dead Sea sediments raised from water depths of 25, 30 and 318 m. The salinity of the pore water is close to that of the overlying water at 225-230 g/L chloride. The titration alkalinity of the pore water is about 60% of the overlying water, and sulfate is also depleted. Ammonia and phosphate concentrations are higher than those of the water column with up to 50 mg/L N-NH3 (ten times increase) and 350 micro g/L P-PO4(3-) (four to eight times increase). Early diagenetic reactions are a result of decomposition of organic matter and of water-sediment interactions which result in aragonite precipitation and phosphate removal to the sediments, probably by absorption of iron-oxyhydrides followed by remobilization, reduction of sulfate and formation of iron sulfides and accumulation of ammonia. Mass balance calculations show that pore water contributes about 80% of the ammonia and 30% of the phosphate input into the Dead Sea water column. The Dead Sea behaves in many respects as a 'marine' system where the sediments are a very important source of nutrients. This differs from the situation in many lakes where various types of surface water input can be a major source of nutrient. (Agostine-PTT)
W91-00742

SOLUBILITY OF OXYGEN IN THE DEAD SEA BRINE.
Kinneret Limnological Lab., Tiberias (Israel).
For primary bibliographic entry see Field 2K.
W91-00744

VERNAL MICROSTRATIFICATION PATTERNS IN A MEROMICTIC SALINE LAKE: THEIR CAUSES AND BIOLOGICAL SIGNIFICANCE.
British Columbia Univ., Vancouver. Dept. of Zoology.
T. G. Northcote, and K. J. Hall.
Hydrobiologia HYDRB8, Vol. 197, p 105-114, May 31, 1990. 5 fig, 22 ref. NSERC Grants 67-3454 and 67-8935.

Descriptors: *British Columbia, *Lakes, *Limnology, *Meromictic lakes, *Saline lakes, *Seasonal variation, *Stratification, Anoxic conditions, Chemocline, Dissolved oxygen, Interfaces, Nutrients, Organic matter, Particulate matter, Photosynthesis, Runoff, Snowmelt.

Periodic high spring runoff, in addition to lake surface snow and ice melt, is shown to be a major cause of sharp secondary chemocline formation in a small (20 ha) lake in arid south-central British Columbia. Initially detected in 1982 at about 1 m and enhanced by high inflow of low salinity meltwater in spring 1983, the secondary chemocline gradually deepened and broke down over four subsequent years. Associated with microstratification layers (major changes within a few cm of depth), exhibited very high temperatures (> 30 C), and very high dissolved oxygen (> 200% saturation) as well as very low (close to 0% saturation) levels. Oxygen supersaturation resulted from photosynthetic production at the microstratification boundaries. In the springs of 1982 and 1983, formation of an anoxic layer between regions of high oxygen concentration separated the phytoplankton and zooplankton communities into two layers above the primary chemocline. The several year persistence of the secondary chemoclines and associated interface processes (concentration of particulate organic matter, bacterial decomposition, nutrient regeneration, phytoplanktonic production) attest to their functional importance in this meromictic lake. (Author's abstract)
W91-00745

PRODUCTION AND DECOMPOSITION IN A SALINE MEROMICTIC LAKE.

British Columbia Univ., Vancouver. Westwater Research Centre.
K. J. Hall, and T. G. Northcote.
Hydrobiologia HYDRB8, Vol. 197, p 115-128, May 31, 1990. 3 fig, 5 tab, 40 ref. NSERC Grants 67-8935 and 67-3454.

Descriptors: *Aquatic productivity, *Decomposition, *Lakes, *Limnology, *Meromictic lakes, *Productivity, *Saline lakes, Aquatic bacteria, British Columbia, Chemocline, Light penetration, Microorganisms, Mixolimnion, Phosphorus, Phytoplankton, Radioactive tracers, Seasonal variation, Stratification, Sulfur bacteria, Tritium.

Bacterial and phytoplankton cell number and productivity were measured in the mixolimnion and chemocline of saline meromictic Mahoney Lake during the spring (Apr.-May) and fall (Oct.) between 1982 and 1987. High levels of bacterial productivity (tritium labelled thymidine incorporation), cell numbers, and heterotrophic assimilation of C-14 glucose and C-14 acetate in the mixolimnion shifted from near surface (1.5 m), at a secondary chemocline, to deeper water (4-7 m) as this zone of microstratification gradually weakened during a several year drying trend in the watershed. In the mixolimnion, bacterial carbon (13-261 microgram C/L) was often similar to phytoplankton carbon (44-300 microgram C/L) and represented between 14-57% of the total microbial (phytoplankton + bacteria) carbon depending on the depth interval. Phototrophic purple sulfur bacteria were stratified at the permanent primary chemocline (7.5-8.3 m) in a dense layer (POC 250 mg/L, bacteriochlorophyll a 1500-7000 microgram/L) where H2S changed from 0.1 to 2.5 mM over a 0.2 m depth interval. This phototrophic bacterial layer contributed between 17-66% of the total primary production (115-476 mg C/sq m/d) in the vertical water column. Microorganisms in the phototrophic bacterial layer showed a higher uptake rate for acetate (0.5-3.7 microgram C/L) and this heterotrophic activity as well as bacterial productivity were 1 to 2 orders of magnitude higher in the dense plate than in the mixolimnetic waters above. Primary phytoplanktonic production in the mixolimnion was limited by phosphorus while light penetration appeared to regulate productivity of the purple sulfur bacteria. (Author's abstract)
W91-00746

AUTUMNAL MIXING IN MAHONEY LAKE, BRITISH COLUMBIA.

British Columbia Univ., Vancouver. Dept. of Civil Engineering.
P. R. B. Ward, K. J. Hall, T. G. Northcote, W. Cheung, and T. Murphy.
Hydrobiologia HYDRB8, Vol. 197, p 129-138, May 31, 1990. 6 fig, 1 tab, 19 ref.

Descriptors: *British Columbia, *Lakes, *Limnology, *Mixing, *Saline lakes, *Seasonal variation, Convection, Mahoney Lake, Meteorological data, Physical properties, Salinity, Stratification, Wind.

Salinity, water temperature and meteorological measurements were made over a 5 month period (June-Oct.) at Mahoney Lake, British Columbia to study autumnal mixing. The measurements were made during a time when the lake had been well stratified by a much larger than average runoff the previous spring. The potential energy of stratification decreased from 50 to 24 MJ, in the top 8 m of the water column, from mid August to mid October. Analysis of the energy available from wind shear on the water surface and from penetrative convection during the autumn cooling period was made. Winds were found to be weak (av. 2.17 m/s) at Mahoney Lake, and their average contribution to mixing energy during the study period was less than 30%. Penetrative convection from thermals descending from the cool surface contributed an average of 2.21 J/sq m/d to mixing which represented 72% of the energy available. An efficiency factor of 0.20 for the penetrative convection energy, larger than values previously reported in the literature, was found to fit the measured loss of potential energy of stratification during the period. (Author's abstract)
W91-00747

CHANGES IN LAKE LEVELS, SALINITY AND THE BIOLOGICAL COMMUNITY OF GREAT SALT LAKE (UTAH, USA), 1847-1987.

Geological Survey, Salt Lake City, UT.
D. W. Stephens.
Hydrobiologia HYDRB8, Vol. 197, p 139-146, May 31, 1990. 5 fig, 18 ref.

Descriptors: *Great Salt Lake, *Lakes, *Limnology, *Saline lakes, *Salinity, *Utah, *Water chemistry, Algae, Aquatic life, Brine shrimp, Ecosystems, Elevation, Evaporation, Killifish, Precipitation.

The effect of major changes in lake elevation and salinity on the biological community of Great Salt Lake were studied. Great Salt Lake is the fourth largest terminal lake in the world, with an area of about 6000 square kilometers at its historic high elevation. Since its historic low elevation of 1277.52 meters in 1963, the lake has risen to a new historic high elevation of 1283.77 meters in 1986-87, a net increase of about 6.25 meters. About 60 percent of this increase, 3.72 meters, has occurred since 1982 in response to greater than average precipitation and less than average evaporation. Variations in salinity have resulted in changes in the composition of the aquatic biological community which consists of bacteria, protozoa, brine shrimp and brine flies. These changes were particularly evident following the completion of a causeway in 1959 which divided the lake. Subsequent salinities in the north part of the lake have ranged from 16 to 29 percent and in the south part from 6 to 28 percent. Accompanying the rise in lake elevation from 1982 to 1987 have been large decreases in salinity of both parts of the lake. This has resulted in changes in the biota from obligate halophiles, such as Dunaliella salina and D. viridis, to opportunistic forms such as a blue-green alga (Nodularia spumigena). The distribution of brine shrimp (Artemia salina) in the lake have also closely followed the salinity. In 1986, when the salinity of the south part of the lake was about 6 percent, a population of brackish-water killifish (Lucania parva) was observed along the shore near inflow from a spring. (Author's abstract)
W91-00748

LARGE-SCALE PATTERNS OF NODULARIA SPUMIGENA BLOOMS IN PYRAMID LAKE, NEVADA, DETERMINED FROM LANDSAT IMAGERY: 1972-1986.

Arizona State Univ., Tempe. Dept. of Zoology.
D. L. Galat, J. P. Verdin, and L. L. Sims.
Hydrobiologia HYDRB8, Vol. 197, p 147-164, May 31, 1990. 7 fig, 1 tab, 59 ref. U.S. EPA Contract 68-03-6242.

Descriptors: *Algal blooms, *Cyanophyta, *Lakes, *Limnology, *Nevada, *Pyramid Lake, *Remote sensing, *Saline lakes, *Satellite technology, *Telemetry, Analytical techniques, Biomass, Calcium carbonate, Chlorophyll a, Fluvial sediments, Landsat images, Meromixis, Periodicity, Quantitative analysis, Spectral analysis, Statistical analysis.

Magnitude and long-term periodicity of the nitrogen-fixing cyanobacterium, Nodularia spumigena, were characterized for hyposaline Pyramid Lake, Nevada, from Landsat multispectral scanner (MSS) band 3 film negatives. Predicted lakewide mean chlorophyll a concentrations for Landsat overpasses during the July-October Nodularia bloom season ranged from 27 to 72 mg/ cu m with an overall average concentration of 32 plus or minus 7 mg/ cu m between 1972 and 1986. Nodularia blooms were usually annual events. Blooms were not observed on Landsat images in only three of 15 years (1973, 1980, 1982) and midsummer calcium carbonate whitings occurred in two of these years (1973, 1980). Magnitude of Nodularia blooms was highly variable among years and 'very large' blooms, where maximum mean chlorophyll a concentration exceeded one standard deviation of the 15 year overall mean (>39 mg/cu m), appeared in 1974, 1975, 1977, 1979, 1984, 1985 and 1986. Very large early-July blooms always occurred during or following years of above average fluvial discharge to Pyramid Lake (1984-1986) and were associated with meromixis produced by the large influx of freshwater. Several problems arise using Landsat remote sensing to estimate magnitude and periodicity of scum-forming blue-green algal blooms which complications may reduce accuracy and precision of phytoplankton biomass estimates made from Landsat images. Nevertheless, Landsat remote sensing enabled quantitation of relative bloom magnitude with limited collection of ground-based data and at large-scale temporal and spatial resolution not possible using alternative methodologies. (Author's abstract)
W91-00749

PHOTOSYNTHESIS OF DUNALIELLA PARVA LERCHE AS A FUNCTION OF TEMPERATURE, LIGHT AND SALINITY.

Malaga Univ. (Spain). Dept. de Ecologia.
C. Jimenez, F. X. Niell, and J. A. Fernandez.
Hydrobiologia HYDRB8, Vol. 197, p 165-172, May 31, 1990. 7 fig, 2 tab, 24 ref. C.A.I.C.Y.T. 1063/85.

Descriptors: *Algae, *Chlorophyta, *Flagellates, *Photosynthesis, *Salinity, *Temperature effects, Lagoons, Light intensity, Michaelis-Menten functions, Model studies, Sodium chloride.

The photosynthetic behavior of Dunaliella parva Lerche from the athalassic lagoon of Fuente de Piedra (Malaga, Southern Spain) was studied experimentally at three NaCl concentrations (1, 2 and 3 M), five temperatures (15, 23, 31, 38 and 42 C) and nine different irradiances between 82 and 891 mol/sq m/s. Results were analyzed to define the best growing conditions for the algae. D. parva showed the highest photosynthetic rates at a NaCl molarity of 2 M, under a moderate light intensity (600 mol/sq m s) at 31 C. Above this light intensity a clear photoinhibition of the photosynthesis was found at 2 M and 3 M of NaCl. D. parva is a halotolerant and a thermoresistant species as evidenced by its net photosynthesis rate and positive values of oxygen evolution at 42 C. Two methods for modeling photosynthesis versus irradiation curves were used. The first was a single model, based on third-order polynomial equations, and the second was a double model, based on hyperbolical Michaelis-Menten type functions and negative exponential to define photoinhibition. It was found that a double model seemed to be very accurate. (Author's abstract)
W91-00750

DISTRIBUTION AND ABUNDANCE OF LITTORAL BENTHIC FAUNA IN CANADIAN PRAIRIE SALINE LAKES.

Saskatchewan Univ., Saskatoon. Dept. of Biology.
U.T. Hammer, J. S. Sheard, and J. Kranabetter.
Hydrobiologia HYDRB8, Vol. 197, p 173-192, May 31, 1990. 7 fig, 6 tab, 27 ref. NSERC Grant 1412.

Descriptors: *Aquatic animals, *Benthic fauna, *Canada, *Lakes, *Limnology, *Littoral environment, *Prairies, *Saline lakes, Biomass, Crustaceans, Organic matter, Salinity, Seasonal variation, Sediments, Species diversity, Statistical analysis, Water chemistry.

The littoral benthos of 18 lakes in Alberta and Saskatchewan ranging in Salinity from 3 to 126 ppt (g/L total dissolved solids(TDS)) was investigated twice, in the spring and in the summer of 1986. Multiple Ekman dredge samples were taken at water depths of about 0.5, 1.0 and 2 meters in each transect. A total of 76 species was present varying from 29-31 species in the three lakes of lowest salinity (means of 3.1-5.55 ppt) to only 2 species in lakes exceeding 100 ppt. Species richness decreased rapidly in salinities greater than 15 ppt. Biomass maximum mean of 10.91 g/sq m dry weight (maximum 63.0 g/sq m) occurred in culturally eutrophic Humboldt Lake (3.1 ppt) but was one third as great in other low salinity lakes. However, biomass again increased to about 4.5 g/sq m in two lakes of 15 ppt. As the salinity increased still further, biomass declined steadily until a minimum of 0.0212 g/sq m was recorded in the most saline Aroma Lake (mean 119 ppt). Summer biomass (11 lakes) was greater than spring biomass (4 lakes) because some groups such as amphipods, corixids and ostracods became more abundant in

summer. Seasonality (spring or summer), sediment texture and organic matter content, water depth, pH, salinity (TDS) and the presence of aquatic plants (% plant cover) were considered in the matrix involving species dry weight biomass at each of 117 stations. TWINSPAN classification of the samples yielded a dendrogram with 18 indicator species. Successive dichotomies divided these indicator species into four main lake groups based on salinity, i.e., Group (I): 3-10 ppt (Gammarus, Glyptotendipes I, Chironomus cf. plumosus), Group (II): 10-38 ppt (Hyalella, Engallagma, Bezzia), Group (III): 38-63 ppt (Hygrotus salinarius, Cricotopus ornatus), Group (IV): >63 ppt (Dolichopodidae, Ephydra hians). Each of these main four groups was subdivided into smaller groups of lakes based on factors such as pH, seasonality (spring or summer species dominance), % organic matter and % plant cover. Depth of samples played no apparent role. (Author's abstract)
W91-00751

DISTRIBUTION AND ABUNDANCE OF THE ALKALI FLY (EPHYDRA HIANS) SAY AT MONO LAKE, CALIFORNIA (USA) IN RELATION TO PHYSICAL HABITAT.

Sierra Nevada Aquatic Research Lab., Mammoth Lakes, CA.
D. B. Herbst.
Hydrobiologia HYDRB8, Vol. 197, p 193-205, May 31, 1990. 7 fig, 2 tab, 21 ref. NSF Grant DCB-8608664.

Descriptors: *Aquatic habitats, *Aquatic insects, *California, *Ecological distribution, *Lakes, *Limnology, *Saline lakes, Alkali fly, Aquatic populations, Distribution, Life cycles, Mono Lake, Substrates, Temperature effects.

The distribution and abundance of larval, pupal, and adult stages of the alkali fly Ephydra hiens Say were examined in relation to location, benthic substrate type, and shoreline features at Mono Lake. Generation time was calculated as a degree-day model for development time at different temperatures, and compared to the thermal environment of the lake at different depths. Larvae and pupae have a contiguous distribution and occur in greatest abundance in benthic habitats containing tufa (a porous limestone deposit), and in least abundance on sand or sand/mud substrates. Numbers increase with increasing areas of tufa present in the sample, but not on other rocky substrates (alluvial gravel/cobble or cemented sand). Standing rock densities are greatest at locations around the lake containing a mixture of tufa deposits, detrital mud sediments, and submerged vegetation. Shoreline adult abundance is also greatest in areas adjacent to tufa. The shore fly (ephydrid) community varies in composition among different shoreline habitats and shows a zonation with distance from shore. The duration of pupation becomes shorter as temperature increases. The temperature dependence of pupa development time is not linear and results in prolonged time requirements to complete development at temperatures below 20 C. About 700 to 1000 degree-days are required to complete a generation. Degree-days of time available in nature declines by 10 to 50% at depths of 5 and 10 meters relative to surface waters (depending on the extent of mixing), resulting in fewer possible generations. Essentially no growth would be expected at 15 m, where temperature seldom exceeds the developmental minimum. It is concluded that reduced substrate availability and low temperatures may limit productivity of the alkali fly at increasing depths in Mono Lake. (Author's abstract)
W91-00752

DISTRIBUTION PATTERNS OF OSTRACODS IN IBERIAN SALINE LAKES. INFLUENCE OF ECOLOGICAL FACTORS.

Museo Nacional de Ciencias Naturales, Madrid (Spain).
A. Baltanas, C. Montes, and P. Martino.
Hydrobiologia HYDRB8, Vol. 197, p 207-220, May 31, 1990. 5 fig, 2 tab, 58 ref. C.A.I.C.Y.T. project PR84-0181.

Descriptors: *Crustaceans, *Distribution patterns, *Ecological effects, *Lakes, *Ostracods, *Saline lakes, *Spain, Iberian Peninsula, Limnology, Mediterranean Sea, Salinity, Sulfates, Waterfowl.

A limnological survey of the Iberian mesosaline and hypersaline lakes was conducted that included a study of the biogeographical and ecological aspects of their ostracod populations. Eucypris aragonica Brehm and Margalef; Eucypris mareotica (Fischer) and Heterocypris barbara inermis (Gauthier) are the only species found in waters with salinities between 10 and 100 ppt. Each species tends to be restricted to one of the three large Iberian Tertiary depressions: E. aragonica in the Ebro River basin; E. mareotica in the Guadalquivir River basin (South Spain) and H. barbara inermis in the tableland of La Mancha (Central Spain). Both E. mareotica and H. barbara inermis are distributed in inland waters of regions around the Mediterranean Sea, while E. aragonica is only known from Spain. Historical factors have been traditionally used to account for the distribution of several crustacean species and recent faunas have been seen as the remnant of those inhabiting Tertiary Depressions around the ancient Mediterranean Sea. Ecological factors, mainly ion composition, account for their observed pattern in Spanish lakes. E. mareotica typically inhabits high chloride waters while H. barbara inermis 'prefers' lakes with high sulfate. E. aragonica seems to be restricted to chloride waters with a high sulfate content and very irregular (or aperiodic) hydrological regimes. Presence of parthenogenetic populations and waterfowl exchange between different saline-lake areas in the Iberian Peninsula facilitate ostracod dispersion. (Author's abstract)
W91-00753

ANOSTRACA, CLADOCERA AND COPEPODA OF SPANISH SALINE LAKES.

Barcelona Univ. (Spain). Dept. de Ecologia.
M. Alonso.
Hydrobiologia HYDRB8, Vol. 197, p 221-231, May 31, 1990. 4 fig, 4 tab, 34 ref.

Descriptors: *Crustaceans, *Lakes, *Limnology, *Saline lakes, *Spain, *Waterfleas, Cladocera, Copepods, Distribution patterns, Fairy-shrimp, Mediterranean Sea, Salinity.

A study of 102 samples from almost all salt water bodies in Spain resulted in a comprehensive list of anostracans, cladocerans and copepods living in such extreme environments. Among the 26 species recorded, 9 are halobionts, but 17 can exist in less saline waters. Of the halobionts, several are widely distributed throughout arid areas around the Mediterranean (Arctodiaptomus salinus, Cletocamptus retrogressus, Branchinectella media, Branchinella spinosa, Daphnia mediterranea, Moina salina); Branchinecta orientalis (= B. cervantesi) only appears in the Guadiana watershed and toward the east of Hungary, and the Alona belonging to the A. elegans complex is a Spanish endemic. In the second group there are many typically freshwater species which also appear occasionally in saline waters, and colonizers of wetlands in steppes, characteristically adapted to a wide range of salinity; one of the typically freshwater species, Diaphanosoma cf. mongolianum deserves closer study. The Spanish halobiontic fauna seems to be very old judging by the existence of some isolated species. e.g., B. orientalis may be a tertiary relic. Persistence through time could have resulted from the continuous aridity of some Iberian localities during the Pleistocene and the ecological constancy of wetlands maintained by regional groundwater discharges. (Author's abstract)
W91-00754

ARTEMIA MONICA CYST PRODUCTION AND RECRUITMENT IN MONO LAKE, CALIFORNIA, USA.

California Univ., Santa Barbara. Marine Science Inst.
G.L. Dana, R. Jellison, and J. M. Melack.
Hydrobiologia HYDRB8, Vol. 197, p 233-243, May 31, 1990. 4 fig, 1 tab, 22 ref.

Descriptors: *Brine shrimp, *California, *Crustaceans, *Lakes, *Saline lakes, Aquatic populations, Eggs, Life cycles, Mixolimnion, Population density, Recruitment, Seasonal variation, Temperature effects.

Annual egg production was determined for Artemia monica in Mono Lake, California, from 1983 to 1987. Annual oviparous (overwintering cyst) production was 3 and 7 million cysts/sq m/y in 1986 and 1987, respectively, as measured by in situ sediment traps. Cyst production for the entire five year period was calculated using Artemia census data and inter-brood duration derived from mixolimnetic temperature. These estimates ranged from 2 to 5 million cysts/sq m/y. This method underestimated annual production by 30%, when compared to estimates using sediment traps. Cyst production was similar during 1983-1986 and showed a significant increase in 1987, which was due primarily to a larger reproductive population later in the year. Recruitment into the adult populations of the following spring ranged between 1.4 to 3.2%. Overall abundance of this generation reflected the patterns in annual cyst production. Compensatory effects must operate on the second generation of each year, since summer populations were similar in all years despite differences in cyst production. (Author's abstract)
W91-00755

COMPARATIVE LIMNOLOGY OF SAMBHAR AND DIDWANA LAKES (RAJASTHAN, NW INDIA).

Jodhpur Univ. (India). Dept. of Zoology.
G. R. Jakher, S. C. Bhargava, and R. K. Sinha.
Hydrobiologia HYDRB8, Vol. 197, p 245-256, May 31, 1990. 7 fig, 3 tab, 24 ref.

Descriptors: *India, *Lakes, *Limnology, *Saline lakes, *Water chemistry, Alkalinity, Aquatic life, Aquatic plants, Brine shrimp, Chemical properties, Comparison studies, Dissolved oxygen, Environmental effects, Nutrients, Plankton, Salinity, Seasonal variation.

Two alkaline saline inland lakes of the Indian arid region were studied during 1984 and 1985 to assess the function and interaction of various environmental and biological factors. Changes in physical and chemical variables, planktonic composition, chlorophyll content and phytoplankton primary productivity were examined. Salinity in both lakes fluctuated from almost fresh water (1.80 ppt), to hypersaline (300 ppt) and acted as the main controlling factor for almost all the biotic parameters. Maximum total alkalinities were 2162 mg/L and 2090 mg/L, respectively in Sambhar and Didwana lakes. Dissolved oxygen ranged from completely anoxic conditions to maxima of 11.68 and 7.29 mg/L, respectively in Sambhar and Didwana lakes. Nutrient enrichment in the lakes was low. The phytoplankton species composition of Sambhar lake was reduced from an earlier reported 20 genera to only 11, including Nostoc and Microcystis. Phytoplankton of Didwana was composed of only 9 genera including Anabaena and Nodularia. Sambhar lake, which once contained Artemia, is now devoid of them. On the other hand, Artemia was the most abundant zooplankter in Didwana lake at a salinity range of 15-288 ppt. Other zooplankters such as Moina, Cyclops and Brachionus flourished at lower salinity levels in Didwana lake. Species number decreased in Sambhar and Didwana lakes as salinity increased. A high carbonate concentration has also been mentioned as a limiting factor for many algal species, because it can be the reason for absence of free CO2. Low species number has also been reported from many other saline lakes around the world. (Agostine-PTT)
W91-00756

SALINITY AS A DETERMINANT OF SALT LAKE FAUNA: A QUESTION OF SCALE.

Adelaide Univ. (Australia). Dept. of Zoology.
W. D. Williams, A. J. Boulton, and R. G. Taaffe.
Hydrobiologia HYDRB8, Vol. 197, p 257-266, May 31, 1990. 3 fig, 2 tab, 35 ref.

Descriptors: *Australia, *Lakes, *Limnology, *Saline lakes, *Salinity, *Species diversity, *Water chemistry, Distribution, Ecological effects, Fauna, Invertebrates, Species composition.

High and often variable salinity is an obvious feature of salt lakes. Correspondingly, salinity is usually assumed to be an important ecological determinant in such lakes. An investigation of the macroinvertebrate fauna of 79 lakes (salinities from 0.3 to 343 g/L) in the Western District of Victoria, Australia, examined this assumption. Over the total range of salinity, species richness and composition were highly correlated with salinity. However, these relationships became nonsignificant over intermediate ranges of salinity. Furthermore, many taxa have very broad tolerances to salinity at these intermediate ranges, implying that factors other than salinity may determine their distribution. An appreciation of scale (that is, the range of salinity over which observations are considered) resolved the paradox that, despite these broad tolerances by most taxa, species richness and composition strongly reflect salinity over the entire salinity range. (Author's abstract)
W91-00757

MULTIVARIATE ANALYSIS OF DIATOMS AND WATER CHEMISTRY IN BOLIVIAN SALINE LAKES.
Museume National d'Histoire Naturelle, Paris (France). Lab. de Geologie.
S. Servant-Vildary, and M. Roux.
Hydrobiologia HYDRB8, Vol. 197, p 267-290, May 31, 1990. 8 fig, 7 tab, 42 ref.

Descriptors: *Bolivia, *Diatoms, *Lakes, *Limnology, *Mathematical studies, *Multivariate analysis, *Saline lakes, *South America, *Statistical analysis, *Water chemistry, Cluster analysis, Ecological distribution, Ecological effects, Flora, Lake classification, Model studies, Physical properties.

Diatom assemblages from thirteen salt lakes in the southern Bolivian Altiplano (Lipez) were studied. The study involved: (1) an inventory of the diatom species; (2) a classification of the lakes based on the diatom flora using correspondence factor and cluster analysis; (3) an ordering of the species inside a cluster, using an 'interpreting help' method to determine the degree of relation of the subdominant or scarce species to a given milieu; (4) the determination of the ionic elements which mostly influence a diatom assemblage, using the 'variables/classes' and 'classes/variables' contributions program; and (5) the quantification of the chemical variables, using an 'interactions species/ionic variables' program which puts into the same graph, samples and/or species and ionic elements whose concentration is expressed in categories. These new methods are proposed to establish the qualitative and quantitative relationships between diatom floras and ecological parameters. Results indicate that diatom assemblages are linked more to the ionic elements than to the salinity, pH, depth, temperature or elevation. Environmental variables are divided into three modalities which allow considerations of many different variables not under the same units: (i) comparisons between published and local affinities to the salinity; (ii) relationships between salinity, number of species and diversity in the Lipez area; and (iii) relationships between salinity and dominant species. (Agostine-PTT)
W91-00758

HYDROCHEMISTRY FROM SR AND MG CONTENTS OF OSTRACODES IN PLEISTOCENE LACUSTRINE DEPOSITS, BAZA BASIN (SE SPAIN).
Instituto de Investigaciones Geologicas Jaime Almera, Barcelona (Spain).
P. Anadon, and R. Julia.
Hydrobiologia HYDRB8, Vol. 197, p 291-303, May 31, 1990. 8 fig, 1 tab, 24 ref.

Descriptors: *Crustaceans, *Heavy metals, *Lacustrine environment, *Limnology, *Magnesium, *Paleolimnology, *Saline lakes, *Spain, *Strontium, *Water chemistry, Baza Basin, Calcite, Carbonates, Environmental effects, Littoral environment, Ponds, Salinity.

A reconstruction of the early Pleistocene paleohydrochemistry based on the Mg, Sr and Ca content of the Cyprideis valves is presented for shallow lacustrine sequences of the Baza basin. A large number of environmental changes in this marginal area has been recorded by the recurrent alternation of two fossil assemblages which differ in their salinity requirements. Measurements of the Sr/Ca and Mg/Ca ratios of individual calcite shells of Cyprideis show that the water in the higher saline stages (with thalassic organisms indicating marine-like conditions) was of non-marine origin. The Sr/Ca values of Cyprideis valves from sands deposited during a saline water phase show lower values than those from an overlying carbonate sequence which was formed under lower salinity conditions. These unexpected values are assumed to be the result of major changes in the chemical composition of water in shallow, littoral ponded areas of a hydrologically complex lake. In the sequences that originated in these areas, Sr/Ca values may be used only as salinity indicators within each portion of the sequence formed in a single, continuous evolution. In more open areas, the wide fluctuations of Sr/Ca and Mg/Ca recorded in ostracods from individual layers of rippled ostracode-shell sands probably reflect the mixing of valves from changing short-term environmental conditions. (Author's abstract)
W91-00759

ABSOLUTE DATING OF SEDIMENTATION ON LAKE TORRES WITH SPRING DEPOSITS, SOUTH AUSTRALIA.
Zambia Univ., Lusaka. School of Mines.
R. M. Schmid.
Hydrobiologia HYDRB8, Vol. 197, p 305-308, May 31, 1990. 1 fig, 5 ref.

Descriptors: *Australia, *Lakes, *Radioactive dating, *Sedimentation, Alluvial deposits, Calcium carbonate, Carbon radioisotopes, Playas, Radioisotopes, Sediments, Tectonics, Travertine.

The travertine structure containing Mountford Spring is in the only surface accumulation of CaCO3 on Lake Torrens, a playa in South Australia. Samples from the travertine structure on Lake Torrens were collected in August 1984 and analyzed through thin section interpretation. The first C-14 data on Lake Torrens for travertine samples surrounding Mountford Spring range from 13,770 plus or minus 130 years BP to 22,700 plus or minus 290 years BP, giving a time frame for lacustrine sediments in between. In the absence of recent tectonic movements, the old travertine (22,700 +/- 290 years) on the cliff top, surrounded by younger spring deposits (13,770 +/-130 years) at a lower level, prove a deflation event at this playa. This compares well with a period of alluvation and dune building in the surroundings of Lake Torrens, occurring between 5000-12,000 years BP. (Agostine-PTT)
W91-00760

CONTROL OF PHYTOPLANKTON GROWTH IN NUTRIENT RECYCLING ECOSYSTEMS. THEORY AND TERMINOLOGY.
Bergen Univ. (Norway). Dept. of Microbiology and Plant Physiology.
T. F. Thingstad, and E. Sakshaug.
Marine Ecology Progress Series MESEDT, Vol. 63, No. 2/3, p 261-272, May 29, 1990. 6 fig, 2 tab, 43 ref.

Descriptors: *Cycling nutrients, *Nutrients, *Phytoplankton, *Theoretical analysis, Biomass, Food chains, Growth, Mathematical studies, Model studies, Oligotrophic lakes, Species composition.

Some of the principles governing phytoplankton growth, biomass, and species composition in 2-layered pelagic ecosystems are explored using an idealized, steady-state, mathematical model based on simple extensions of Lotka-Volterea type equations. In particular, the properties of a food web based on 'small' and 'large' phytoplankton are investigated. Features of the phytoplankton community that may be derived from this conceptually simple model include co-existence of more than one species on one limiting nutrient, a rapid growth rate for a large fraction of the phytoplankton community in oligotrophic waters, a long food chain starting from a population of small phytoplankton in waters with moderate mixing over the nutricline, and a transition to dominance of a food chain based on large phytoplankton when mixing is increased. As pointed out by other authors, careless use of the concept of one limiting factor may be potentially confusing in such systems. To avoid this, a distinction in terminology between 'controlling' and 'limiting' factors is suggested. (Author's abstract)
W91-00765

CLASSIFICATION OF THE MACROINVERTEBRATE FAUNA OF TWO RIVER SYSTEMS IN SOUTHWESTERN AUSTRALIA IN RELATION TO PHYSICAL AND CHEMICAL PARAMETERS.
Western Australia Univ., Nedlands. Aquatic Research Lab.
A. W. Storey, S. E. Bunn, P. M. Davies, and D. H. Howard.
Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 3, p 217-232, June/July 1990. 4 fig, 4 tab, 38 ref.

Descriptors: *Australia, *Invertebrates, *River systems, *Species composition, *Species diversity, Agriculture, Classification, Geomorphology, Ordination, Seasonal variation, Spatial distribution, Temporal distribution, Urban planning, Water chemistry.

Benthic macroinvertebrates were quantitatively sampled from thirty sites along two river systems in southwestern Australia, and patterns in community structure related to physical and chemical parameters. Classification and ordination showed a major separation between upland and lowland sites, irrespective of river systems. The change in benthic community structure reflected the rapid transition in geomorphology, stream hydraulics, and water chemistry as upland forested streams exit the Darling Escarpment to give rise to open rivers, disturbed by agriculture and urban development. One upland site was clearly influenced by a storage reservoir immediately upstream and consistently grouped with lowland sites; evidence of recovery was apparent at sites downstream. The remaining upland sites were separated on the basis of catchment; this was most likely related to stream flow permanence than any inherent catchment difference. A seasonal pattern was also detected for upland sites. Samples taken in the summer or autumn were distinct from those taken in winter or spring. In contrast, lowland sites could not be separated into distinct groups on the basis or season or drainage basin. The presence of cosmopolitan and tolerant species with a high likelihood of dispersal, together with the homogeneous nature of the sites, may account for the high degree of similarity among benthic communities of sites along the lowland rivers. Much of the spatial and temporal variation in benthic community structure was explained by physical characteristics of the sites. Prediction of community type using chemical data alone was poor, but might be improved by combining physical and chemical data, particularly for upland sites, and was likely the result of the abrupt changes in the physical nature of the streams and the absence of large spatial differences in water quality. The successful predictive relationship between benthic community structure and physical data will enable water management authorities to detect subsequent changes in water quality in these two river systems. (Author's abstract)
W91-00774

VARIABILITY OF RESULTS FROM THE USE OF PHABSIM IN ESTIMATING HABITAT AREA.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W91-00775

EFFECTS OF SEDIMENT AND FLOW REGIME ON THE AQUATIC INSECTS OF A HIGH MOUNTAIN STREAM.
Wyoming Univ., Laramie. Dept. of Plant Science.
L. D. DeBrey, and J. A. Lockwood.

Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 3, p 241-250, June/July 1990. 5 fig, 2 tab, 39 ref.

Descriptors: *Flow rates, *Insects, *River systems, *Sedimentation, *Stream biota, *Wyoming, Disturbance, Species diversity, Surber sampler.

In 1984, a broad size range of sediment (boulder to sand) was introduced into a high elevation Rocky Mountain stream in southeastern Wyoming, USA. In the spring of 1986, this stream was exposed to a high discharge of 7.5 cubic meters per second. From 1985 to 1987 a study was conducted to assess the impact of sediment deposition and flow regime on the aquatic insect community based on the substrate type where the insects were collected. Using a modified Surber sampler, samples were collected from June through September each year at nine stations which were rated as unimpacted, slightly-impacted, and impacted. The addition of the sediment had minimal impact on the abundance and diversity of aquatic insects. However, high water discharge severely reduced the abundance of aquatic insects and diversity was also negatively impacted. Recovery from these impacts was very rapid. The greatest insect abundance was found in samples taken in gravel and most taxa occurred predominantly on gravel or rubble substrates. (Author's abstract)
W91-00776

ENHANCEMENT OF BENTHIC MACROINVERTEBRATES BY MINIMUM FLOW FROM A HYDROELECTRIC DAM.
Versar, Inc., Columbia, MD.
For primary bibliographic entry see Field 6G.
W91-00778

MARGINAL ZOOBENTHOS OF A SOUTHERN BRAZILIAN DAM (ZOOBENTHOS LITORANEOS DE UM ACUDE SUL-BRASILEIRO).
Museu de Ciencias Naturais de Fundacao Zoobotanica do Rio Grande do Sul, Porto Alegre (Brazil).
For primary bibliographic entry see Field 6G.
W91-00780

CHEMICAL CHARACTERISTICS OF THE WATER OF CHASCOMUS POND (PROVINCIA DE BUENOS AIRES, ARGENTINA): LIMNOLOGICAL IMPLICATIONS (CARACTERISTICAS QUIMICAS DAS AGUAS DA LAGOA DE CHASCOMUS (PROVINCIA DE BUENOS AIRES, ARGENTINA). IMPLICANCIAS LIMNOLOGICAS).
Universidad Nacional de La Plata (Argentina). Inst. de Limnologia.
V. H. Conzonno, and E. F. Claverie.
Revista Brasileira de Biologia RBBIAL, Vol. 50, No. 1, p 15-21, February 1990. 3 fig, 4 tab, 28 ref.

Descriptors: *Argentina, *Lakes, *Limnology, *Water chemistry, Algal growth, Biological oxygen demand, Chascomus Pond, Chlorophyll a, Hydrogen ion concentration, Lake circulation, Limiting nutrients, Nitrogen, Nutrient concentrations, Phosphorus, Salinity.

The chemical characteristics of the waters of Chascomus pond were oligohaline, with mean total dissolved solids of 649 mg/L; alkaline, with a mean pH of 8.6; and of the bicarbonate sodium chloride type. The pond was found in a state of constant vertical mixing, which caused saturated dissolved oxygen levels even near the pond bottom. This vertical mixing promoted the existence of a high concentration of suspended particulate matter (mean of 112.8 mg/L) that greatly affected the transmission of light in the water column. Nutrient concentrations (mean total nitrogen, 1.56 mg nitrogen/L; mean total phosphorus 249 microg phosphorus/L) and pigment concentrations (mean chlorophyll a, 25.3 microg/L) indicated the high trophic status of the pond. Values of total nitrogen/total phosphorus ratios suggested nitrogen, rather than phosphorus, was the limiting nutrient for algal growth. Soluble organic matter levels, measured as chemical oxygen demand, were high, reaching a mean of 13.4 mg of oxygen consumed per L. Heavy rain caused important changes in the characteristics of the water. (Author's abstract)
W91-00781

SEASONAL VARIATION OF SIRODOTIA DELICATULA SKUJA (RHODOPHYTA, BATRACHOSPERMACEAE) IN A SMALL STREAM FROM SAO PAULO STATE, SOUTHEASTERN BRAZIL.
Universidade Estadual Paulista, Sao Jose do Rio Preto (Brazil). Inst. de Biociencias.
D. Pascoaloto, and O. Necchi.
Revista Brasileira de Biologia RBBIAL, Vol. 50, No. 1, p 37-44, February 1990. 13 fig, 28 ref.

Descriptors: *Algae, *Brazil, *Rhodophyta, *Seasonal variation, *Stream ecology, Algal growth, Algal reproduction, Correlation analysis, Population dynamics, Stream order, Water chemistry, Water depth.

Seasonal variation of Sirodotia delicatula was investigated in a first-order stream in Juqutiba, Sao Paulo State, southeastern Brazil, from April, 1987 to April 1988. Seasonality was evaluated on the basis of frequency, percent cover, and phenology, as well as its relation to some physical and chemical variables (current velocity, water temperature, turbidity, width, depth, discharge rate, pH, carbon dioxide levels, oxygen levels, oxygen saturation, water color, and daylength). The alga population revealed no significant variation in frequency, presenting maximum values in June (33.6%) and minimum in September (25.2%) with a narrow range during the study period. Percentage cover showed no seasonality remaining in the level 2 (1-10%) of the cover scale. All plants were fertile and monoecious; most (90-100%) were carposporophytic. In situ carpospore germination, resulting in the development of microscopic plants of Chantrasia stage, epiphytically on the gametophyte, was observed in a variable percentage (5-20%) of plants of the populations from April, May, September, October, and November, 1987 and April, 1988. The alternation between gametophyte and Chantrasia stage, typical of members of Batrachospermales, was not observed. Frequency was positively correlated with depth ($r = 0.55$, $p < 0.05$), suggesting a relationship with luminosity. The relative stability of the Sirodotia delicatula population seems to be due to maintenance of chemical and physical variables within favorable conditions for the growth of the alga. The joint occurrence of carposporophytic and monoecious plants was interpreted as the major factor, as well as an alternative reproductive strategy, for population maintenance under favorable seasonal conditions. (Author's abstract)
W91-00782

FEEDING OF SILVER CARP IN EUTROPHIC LAKE PAPROTECKI IN THE MAZURIAN LAKE REGION: I. CHARACTERISTICS AND EVALUATION OF FEEDING CONDITIONS (ODZYWIANIE SIE TOLPYGI BIALEJ (HYPOPHTHALMICHTHYS MOLITRIX VAL.) W EUTROFICZNYM JEZIORZE PAPROTECKIM NA MAZURACH: I. CHARAKTERYSTYKA I OCENA WARUNKOW POKARMOWYCH).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 8I.
W91-00783

FEEDING OF SILVER CARP IN EUTROPHIC LAKE PAPROTECKI IN THE MAZURIAN LAKE REGION: II. QUALITATIVE AND QUANTITATIVE ANALYSES OF NUTRITION AND NUTRITIONAL SELECTIVITY (ODZYWIANIE SIE TOLPYGI BIALEJ (HYPOPHTHALMICHTHYS MOLITRIX VAL.) W EUTROFICZNYM JEZIORZE PAPROTECKIM NA MAZURACH: II. JAKOSCIOWA I ILOSCIOWA ANALIZA POKARMU ORAZ WYBIORCZOSC POKARMOWA).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 8I.
W91-00784

FEEDING OF SILVER CARP IN EUTROPHIC LAKE PAPROTECKI IN THE MAZURIAN LAKE REGION: III. ATTEMPT TO EVALUATE THE PRESSURE ON PLANKTON OF THE INTRODUCED FISH POPULATION (ODZYWIANIE SIE TOLPYGI BIALEJ (HYPOPHTHALMICHTHYS MOLITRIX VAL.) W EUTROFICZNYM JEZIORZE PAPROTECKIM NA MAZURACH: III. PROBA OCENY PRESJI INTRODUKOWANEJ POPULACJI RYB NA PLANKTON).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 8I.
W91-00785

MICROBIOLOGICAL INVESTIGATIONS OF LAKE NIEGOCIN (BADANIA MIKROBIOLOGICZNE JEZIORA NIEGOCIN).
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Zaklad Mikrobiologii Sanitarnej.
For primary bibliographic entry see Field 5B.
W91-00787

SPECTROSCOPIC INVESTIGATIONS OF PEAT-WATER INTERACTIONS: AN ESR, FT-IR, AND NMR STUDY.
Umea Univ. (Sweden). Dept. of Physical Chemistry.
A. Holmgren, G. Wikander, and B. Norden.
Soil Science SOSCAK, Vol. 149, No. 5, p 279-291, May 1990. 8 fig, 2 tab, 39 ref.

Descriptors: *Bonding, *Limnology, *Peat soils, *Soil chemistry, *Water chemistry, *Wetlands, Correlation analysis, Decomposition, Fourier transformed-infrared spectroscop, Humification, Nuclear magnetic resonance.

Despite the existence of naturally occurring paramagnetic species in peat, it is difficult to use them unambiguously for determination of the water-binding properties of peat. In the present investigation extrinsic probe molecules, viz stable nitroxide radicals, are used. By means of these reporter molecules, it is possible to follow the rate of disappearance of water in peat at various temperatures. Samples from different sorts of peat (Sphagnum and Carex) with various degrees of humification have been investigated and the binding between water and peat have been estimated. The DRIFT technique was used to investigate the interaction between water and homogenized batches of Sphagnum and Carex peat of both high and low degrees of decomposition. As an aid to spectral interpretations, the hydrogen bonding (3700 to 3000 /cm) region of the spectra was analyzed using principal component analysis and partial least squares modeling with latent variables. A very good correlation is obtained between DRIFT data and the water content of the peat samples. Water molecules are more strongly bound to the surface of a high-humified peat sample than to a surface of low-humified peat. The hydrogen bonding interaction between water and functional groups in the peat structure is also reflected by the vibrational spectrum of peat. Carbon-13 labeled CP/MAS nuclear magnetic resonance to monitor changes in chemical composition was used revealing a decrease of carbohydrates and a relative increase in aromatic and aliphatic structures as humification proceeds. Proton spin-spin relaxation measurements were used to detect different fractions of water in peat. The data indicate the existence of a multitude of fractions, which can be interpreted as hard bound water, capillary water, and bulk water. (Author's abstract)
W91-00789

DEGRADATION OF POLYPHENOLS IN FIVE PLANT SPECIES IN THE AQUATIC ENVIRONMENT (DEGRADACAO DE PLOIFENOIS EM CINCO ESPECIES VEGETAIS EM AMBIENTES AQUATICOS).
Convenio Eletronorte/CNPq/INPA, Brazil.
M. N. S. Ribeiro, M. J. C. Varejao, M. G. B. Zoghbi, and J. S. B. Ribeiro.
Acta Amazonica AAMZAZ, Vol. 18, No. 3/4, p 189-197, 1989. 6 fig, 17 ref. English summary.

Descriptors: *Aquatic plants, *Biodegradation, *Degradation, *Fate of pollutants, *Phenols, *Plant physiology, *Polyphenols, *Water chemistry, Aquatic environment, Brazil, Chemical analysis, Lakes, Vegetation effects.

Degradation studies of polyphenols of leaves and branches of Inga species Mabea caudata Pax ex K. Hoffn., Mezilaurus itauba (Messn.) Taub ex Mez., Vatairea sericea Ducke and Protium species were carried out for 155 days in two experimental lakes in the state of Amazonas, Brazil. In the first lake the vegetation remained intact and in the second lake the vegetation was defoliated. Phenolic compound determinations were based on the Follin-Denis method. The object of the present study was to know the degradation rate of phanerogam vegetation in the aquatic environment. Inga sp. and Mezilaurus itauba showed greater decomposition in the first lake than in the second while Mabea caudata and Mezilaurus itauba had a high decomposition in the second lake. (Author's abstract)
W91-00821

INCREASE IN THE OXYGEN CONCENTRATION IN AMAZON WATERS RESULTING FROM THE ROOT EXUDATION OF TWO NOTORIOUS WATER PLANTS, EICHHORNIA CRASSIPES (PONTEDERIACEAE) AND PISTIA STRATIOTES (ARACEAE).
Kiel Univ. (Germany, F.R.). Botanisches Inst.
A. Jedicke, B. Furch, U. Saint-Paul, and U. B. Schluter.
Amazoniana AMAZAP, Vol. 11, No. 1, p 53-69, 1989. 14 fig, 1 tab, 26 ref.

Descriptors: *Aquatic plants, *Floating plants, *Limnology, *Oxygen transfer, *Plant physiology, Amazon, Aquatic environment, Fish, Hypoxia, Photosynthesis, Roots, Tropical regions.

Qualitative and quantitative analyses were carried out to determine the amount of oxygen that enters the water through the root systems of two floating Neotropical plants, Eichhornia crassipes and Pistia stratiotes, under nearly anaerobic conditions. The physiological analyses were supplemented by anatomical investigations. A measurable oxygen input from both plants was detected: that from E. crassipes was 116 mg oxygen/h/sq m and from P. stratiotes, 58 mg oxygen/h/sq m. Water surface area represented 4 kg and 2.9 kg fresh weight, respectively. The oxygen input from E. crassipes seemed to be independent of the amount of photosynthesis, suggesting that a pressure ventilation was responsible for the input. In the case of P. stratiotes, a relationship was found between photosynthetic activity and the oxygen input. These floating plant species which are feared in many tropical ecosystems, because they can quickly cover the entire water surface in a very short time, can play important roles in their natural ecosystems, and the endemic ichthyofauna seems to be well adapted to their activities. (MacKeen-PTT)
W91-00822

NUTRIENT DYNAMICS OF DECOMPOSING LEAVES FROM AMAZONIAN FLOODPLAIN FOREST SPECIES IN WATER.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
K. Furch, W. J. Junk, and Z. E. S. Campos.
Amazoniana AMAZAP, Vol. 11, No. 1, p 91-116, 1989. 14 fig, 7 tab, 62 ref.

Descriptors: *Flood plains, *Forest ecosystems, *Leaves, *Litter, *Nutrient transport, *Nutrients, Amazon River, Calcium, Decomposition, Magnesium, Negro River, Nitrogen, Nutrient concentrations, Phosphorus, Potassium, Rivers, Sodium.

Decomposition experiments were performed in freshwater tanks using fresh leaves of four Amazonian tree species from blackwater and whitewater floodplain forests. Weight loss, loss of the major elements, Na, K, Mg, Ca, N and P from the leaves, and release of these elements into the water were studied during a four month period. Great nutrient loss (up to 89% of total) and dry weight loss (up to 86% of initial biomass) were observed from the nutrient rich leaves of three tree species from the Amazon River floodplain forest. The nutrient poor leaves of a common species from the Negro River floodplain forest decomposed much more slowly. A large portion of the total nutrients lost from the leaves (37-59%) was detected in the water in the form of inorganic ions. Based on the nutrient contents of fresh multispecies leaf litter and data on the shedding of this litter, nutrient inputs from leaves into bodies of blackwater and whitewater in the forests during flood period were calculated. The input of dissolved inorganic N, P and K may be as great or even greater than input from river water, indicating the importance of the floodplain forest as a nutrient pump from sediments into the water. (MacKeen-PTT)
W91-00824

SEASONAL, HYDROLOGICAL, AND LAND MANAGEMENT FACTORS CONTROLLING DISSOLVED ORGANIC CARBON CONCENTRATIONS IN THE LOCH FLEET CATCHMENTS, SOUTHWEST SCOTLAND.
Stirling Univ. (Scotland). Dept. of Environmental Science.
I. C. Grieve.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 231-239, July/September 1990. 3 fig, 2 tab, 26 ref.

Descriptors: *Acid rain effects, *Catchment areas, *Dissolved organic carbon, *Environmental effects, *Forestry, *Liming, *Loch Fleet, *Scotland, *Water quality, *Watershed management, Flow discharge, Organic matter, Peat soils, Stream discharge, Watersheds.

As part of a program investigating the effects of forestry and catchment liming on streams in the Loch Fleet catchment in southwest Scotland, a large number of measurements of dissolved organic carbon (DOC) were made. The catchment covers an area of some 111 ha and the annual rainfall is 2150 mm. Soils are peats and peaty gleys over thin drift and granite bedrock. DOC was measured at hourly or two-hourly intervals during more than 30 events in one forested and two moorland subcatchments of the Loch Fleet catchment. The dominant peaty soils in the catchments resulted in small discharge-related DOC variations within individual events, with a maximum range of about 2 mg/l. At low discharges flow was probably from the basal peat horizon with consequently higher DOC and less variation with discharge. Seasonal variations were larger with an amplitude of 8-9 mg/l and maximum concentrations in the summer months. Variations can probably be explained by the effects of temperature on decomposition rates. The forested stream had the highest mean DOC, twice as large as the comparable moorland stream in the preliming phase. Applications of lime to the catchments increased stream DOC concentrations, with the largest increases in the moorland catchments. This increase may be due either to the lower Al concentrations and reduced precipitation of DOC within the stream, or to the role of higher pH and Ca in stimulating decomposition in the peaty soils. (Korn-PTT)
W91-00862

SPATIAL AND TEMPORAL VARIATION IN FISHES OF RIFFLE HABITATS: A COMPARISON OF ANALYTICAL APPROACHES FOR THE ROANOKE RIVER.
Oklahoma Univ., Kingston. Biological Station.
For primary bibliographic entry see Field 8I.
W91-00868

STUDIES ON THE ALGAE OF A SMALL SOFTWATER STREAM I. OCCURRENCE AND DISTRIBUTION WITH PARTICULAR REFERENCE TO THE DIATOMS.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
E. J. Cox.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 83, No. 4, p 525-552, 1990. 11 fig, 5 tab, 64 ref.

Descriptors: *Algae, *Aquatic habitats, *Diatoms, *Germany, *Stream biota, Acid streams, Ecological distribution, Epilithon, Microenvironment, Periphyton, Seasonal distribution, Seasonal variation, Spatial distribution.

Algal occurrence and distribution, with particular emphasis on the diatoms, were investigated over a 3 year period in a small, softwater upland stream (the Breitenbach). In contrast to most other diatom studies, the species analyses have largely been performed on live material, thus excluding errors introduced by the inwash of species which grew outside the sampling area. Different species dominated in contrasting habitats, e.g. epipelon, epilithon, epiphyton, the first being richest in species and showing the greatest variation over the year. Both species complement and abundance varied along the main part of the stream, while a spring region had a contrasting flora and demonstrated little seasonal periodicity. Although some species have clear seasonal maxima, the presence of many others seems more closely related to their microhabitat. One striking feature of the attached diatom flora is the absence of the almost ubiquitous Cocconeis. Although this species is designated alkaliphilous and is more common in alkaline, eutrophic waters, it grows over a pH range 6.2-9.0 and could therefore be expected in the Breitenach. Several other species common in the Breitenbach are also alkaliphilous or are found in more eutrophic waters so that neither low pH nor low oligotraphy can be invoked to explain the absence of Cocconeis. C. placentula was also found at different times of the year in upland streams in Sauerland. The algal floras in these streams were similar to those in the Breitenbach. However, it is possible that some, at present undetermined, chemical factor, whether limiting or inhibitory, prevents the growth of Cocconeis in the stream. Linked with, if not the cause of, difficulties in interpreting contradictory ecological preferences or responses, are questions of identification and species delimitation. (Hoskin-PTT)
W91-00869

STUDIES ON THE ALGAE OF A SMALL SOFTWATER STREAM II. ALGAL STANDING CROP (MEASURED BY CHLOROPHYLL-A) ON SOFT AND HARD SUBSTRATA.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
E. J. Cox.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 83, No. 4, p 553-566, 1990. 7 fig, 27 ref.

Descriptors: *Algae, *Aquatic habitats, *Chlorophyll a, *Stream biota, Artificial substrates, Chemical analysis, Ecological distribution, Epilithon, Microenvironment, Periphyton, Sandstones, Seasonal distribution, Seasonal variation, Spatial distribution.

Variation in the algal standing crop on different substrata in an upland stream was assessed using chlorophyll-a as a measure. Chlorophyll levels were considerably higher on soft sediments than on natural stones or sandstone tiles, and often approached levels recorded in lowland streams, estuarine or marine coastal habitats. After the flood period, spring and autumn peaks were observed on the epipelon in the middle reach of the stream. A dramatic reduction in chlorophyll levels occurred in March/April due to the spate. Seasonal fluctuations in standing crop were less obvious on natural stones, but spate discharge had a similarly drastic effect on the epilithon. In the spring region epilithic populations were less affected by flood while no clear effect was observed on the epipelon. The use of sandstone tiles as a hard substratum revealed that algal accumulation varied within and between sites, and with season. This was to some extent related to grazing pressure. (See also W91-00869 and W91-00871) (Author's abstract)
W91-00870

STUDIES ON THE ALGAE OF A SMALL SOFTWATER STREAM III. INTERACTION BETWEEN DISCHARGE, SEDIMENT COMPOSITION AND DIATOM FLORA.
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
E. J. Cox.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 83, No. 4, p 567-584, 1990. 12 fig, 30 ref.

Descriptors: *Algae, *Aquatic habitats, *Diatoms, *Sediment analysis, *Stream biota, Ecological distribution, Epilithon, Periphyton, Seasonal distribution, Seasonal variation, Stream discharge.

Grain size analysis was carried out on dried sediments whose epipelic diatom floras had been previously investigated. Changes in the percentages of different particle fractions over a two year period were plotted and compared with changes in percentage abundance of different diatom genera, or groups of genera. Fluctuations in stream discharge were reflected in the relative proportions of coarser and finer sediment, and their relative stability of discharge in a spring region by a more constant, contrasting grain size distribution. Epipsammic and epilithic species were more abundant when the coarser sediment fraction was larger; epipelic Navicula and Nitzschia species increased on finer sediments. Different Navicula species showed contrasting occurrence patterns. The sediments probably act as nutrient traps which results in more eutrophic species on finer sediments. The activity of epipelic algae themselves also modifies the nature of the sediment, fostering more rapid accumulation of fine particles and contributing organic matter. (See also W91-00869 and W91-00870) (Author's abstract)
W91-00871

NON-LINEAR SYSTEM TO DESCRIBE MOVEMENTS OF WATER MASSES AT THE LG-2 RESERVOIR (LA GRANDE, QUEBEC).
Sherbrooke Univ. (Quebec). Dept. of Chemical Engineering.
M. De Broissia, B. Colin, B. Coupal, B. Marcos, and G. Payre.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 193-217, July 1990. 7 fig, 1 tab, 5 ref, append. FCAR no. E.Q. 2452.

Descriptors: *Dam effects, *Flow models, *Hydrologic models, *Limnology, *Model studies, *Quebec, *Reservoirs, Data analysis, Hydrodynamics, Mathematical models.

The movement of water masses in the 'La Grande' (P.Q.) LG-2 reservoir under various operating conditions is considered. Biological models were designed to represent a reservoir of the magnitude of LG-2 as an assemblage of several large homogeneous zones related at their boundaries by means of interzonal flows. The implementation of these models therefore requires knowledge of the flows corresponding to various scenarios, and the work performed provides a practical means of obtaining these quantities. The phenomena are essentially large scale, both in space (zones of several hundreds of square kilometers) and in time, the motion of water in the reservoir being generally slow. This is why average situations have been modeled, in defining various typical regimes, as well as exceptional transitory situations such as flooding periods of limited duration. The winter period during which the reservoir is covered by ice was not considered, nor was the influence of wind. This could have an influence on the movements of the surface, but limited to a period of 10 hours. The model was applied to 15 characteristic situations. For all simulations, the calculated velocities were relatively low, and the highest speeds were observed in the channel at the mouth of LG-3. Since the velocities were quite different, each simulation required two graphics; the first showed the gropu of velocities excluding those in the channel from LG-3; the second provided the velocities in the channel. The results were generally satisfactory. The Newton-Raphson algorithm chosen for solving the nonlinear system converged in all cases, in five iterations, and the speeds obtained were in first analysis, realistic. (Hoskin-PTT)
W91-00885

2I. Water In Plants

COMPARISON OF VESICULAR-ARBUSCULAR MYCORRHIZAE IN PLANTS FROM DISTURBED AND ADJACENT UNDISTURBED REGIONS OF A COASTAL SALT MARSH IN CLINTON, CONNECTICUT, USA.
Connecticut Univ., Storrs. Dept. of Ecology and Evolutionary Biology.
J. C. Cooke, and M. W. Lefor.
Environmental Management EMNGDC, Vol. 14, No. 1, p 131-137, January/February 1990. 7 fig, 1 tab, 47 ref.

Descriptors: *Coastal marshes, *Connecticut, *Marsh plants, *Salt marshes, *Soil fungi, *Wetlands, Cord grasses, Marsh management, Plant populations, Roots, Symbiosis, Vegetation establishment, Wetland restoration.

The association of rhizosphere microorganisms and host roots may be mutually beneficial and may also represent a mutual dependency. Roots of salt marsh plant species Spartina alterniflora, S. patens, Distichlis spicata, and others were examined for the presence of vesicular-arbuscular mycorrhizal (VAM) fungi. Samples were taken from introduced planted material in a salt marsh restoration project and from native material in adjacent marsh areas along the Indian River, Clinton, Connecticut. After ten years the replanted area still has sites devoid of vegetation. The salt marsh plants introduced there were devoid of VAM fungi, while high marsh species from the adjacent undisturbed region showed consistent infection, leading the authors to suggest that VAM fungal infection of planting stocks may be a factor in the success of marsh restoration. (Author's abstract)
W91-00029

EFFECTS OF THE DRY SEASON ON THE VEGETATION CANOPY OF SOME RIVER BASINS OF WEST AFRICA AS DEDUCED FROM NOAA-AVHRR DATA.
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
J. M. Gregoire.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 3, p 323-338, June 1990. 6 fig, 3 tab, 20 ref.

Descriptors: *Africa, *Canopy, *Radiometry, *Remote sensing, *River basins, *Vegetation, Evapotranspiration, Groundwater recharge, Hydrologic models, Infrared imagery, NOAA-AVHRR Imagery, Normalized Difference Vegetation Index, Rainfall-runoff relationships, Satellite technology, Seasonal variation, Sediment transport, Soil erosion.

The vegetation status was characterized over 13 river basins in the Sudanese area of West Africa using the Normalized Difference Vegetation Index (NDVI), computed from channels 1 and 2 of National Oceanographic and Atmospheric Administration Advanced Very-High-Resolution Radiometer (NOAA-AVHRR) imagery, and the radiometric behavior in the middle thermal infrared, channel 3. The frequency distribution of radiometric values, both NDVI and thermal infrared, within the watersheds clearly shows the effect of the dry season on the vegetation canopy. Thermal infrared data seem to be more efficient than NDVI data for characterizing changes in density and vigor of the vegetation canopy, at least at that stage in the year. Channel 1 of AVHRR, being very sensitive to atmospheric conditions, introduces a masking effect on the NDVI temporal behavior during the dry season. Depending on which climatological zone the river basins are in, they react in a specific way in terms of changes in the vegetation canopy status. Also radiometric behavior in the middle thermal infrared band, channel 3 of AVHRR, supplies information on bush fire activity. This process is one of the main agents of vegetation degradation in this part of the world. Here again, results show an evident ecological zoning. Low resolution satellite imagery can be highly efficient for the monitoring of vegetation response to seasonal factors on a regional scale. Vegetation dynamics or changes represent an indispensable set of data for hydrological modeling. They are input for: (a) rainfall-runoff models; (b) ground water recharge studies; and (c) evaluation of evapotranspiration, soil erosion and sediment transport. (Author's abstract)
W91-00410

COMPETITION AND COEXISTENCE IN SUBMERGED AQUATIC PLANT COMMUNITIES: THE EFFECTS OF SPECIES INTERACTIONS VERSUS ABIOTIC FACTORS.
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00423

VARIABILITY OF BIOGENIC SULFUR FLUX FROM A TEMPERATE SALT MARSH ON SHORT TIME AND SPACE SCALES.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
For primary bibliographic entry see Field 2L.
W91-00847

DEPLETION AND RECHARGE OF SOIL WATER IN TWO STANDS OF NORWAY SPRUCE (PICEA ABIES (L.) KARST).
Sveriges Lantbruksuniversitet, Umea. Dept. of Forest Site Research.
For primary bibliographic entry see Field 2G.
W91-00860

MONITORING SPATIAL VARIABILITY OF FOREST INTERCEPTION.
Montreal Univ. (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 2D.
W91-00861

INTERCEPTION LOSS AND RAINFALL REDISTRIBUTION BY THREE SEMI-ARID GROWING SHRUBS IN NORTHEASTERN MEXICO.
Toronto Univ. (Ontario). Faculty of Forestry.
J. Navar, and R. Bryan.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 51-63, July 1990. 6 fig, 39 ref.

Descriptors: *Interception loss, *Plant physiology, *Rainfall distribution, *Semiarid lands, *Vegetation effects, Ecosystems, Semiarid climates, Simulated rainfall, Stemflow, Throughfall.

The role of interception and redistribution of rainfall in water resource management has been a major focus of attention for both temperate and tropical ecosystems. The information available has limited application to semi-arid ecosystems where only a few studies have been carried out. Interception loss and rainfall redistribution were measured in individual shrubs of Diospyrus texana, Acacia farnesiana and Prosopis laevigata from a semi-arid vegetal community in northeastern Mexico in the summer of 1987. In this period 230 mm of precipitation were recorded from 17 storms. Net precipitation averaged 167.6 mm, of which throughfall formed 160.5 and stemflow 7.1 mm. Interception loss was 27.2% of the total gross precipitation. Significant differences in stemflow were noted both among species and within the species D. texana. Stemflow inputs averaged 321 and 115 ml/min for a 40 mm/h simulated storm for the species D. texana and A. farnesiana-P. laevigata, respectively. The theoretical areas and distances over which stemflow spread averaged 0.320 square meters and 0.115 square meters and 0.30 and 0.15 m, respectively. These areas were calculated to receive 3030 and 2650 mm as annual precipitation. (Author's abstract)
W91-00878

EVAPORATION FROM DAMPLAND VEGETATION ON A GROUNDWATER MOUND.
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2D.
W91-00879

GROUNDWATER RESPONSE TO REFORESTATION IN THE DARLING RANGE OF WESTERN AUSTRALIA.
Water Authority of Western Australia, Perth.
For primary bibliographic entry see Field 2F.
W91-00892

2J. Erosion and Sedimentation

DEVELOPMENT AND STRUCTURE OF THE GOCZALKOWICE RESERVOIR ECOSYSTEM. XIX. SUSPENDED-MATTER SEDIMENTATION.
Polish Academy of Sciences, Krakow. Zaklad Ochrony Przyrody i Zasobow Naturalnych.
For primary bibliographic entry see Field 2H.
W91-00005

LOCAL SCOUR PROFILES DOWNSTREAM OF HYDRAULIC JUMP.
Ministry of Energy, Tehran (Iran).
For primary bibliographic entry see Field 8B.
W91-00032

DEPTH-INTEGRATED MODEL FOR SUSPENDED SEDIMENT TRANSPORT.
Technische Hogeschool Delft (Netherlands).
G. Galappatti, and C. B. Vreugdenhil.
Journal of Hydraulic Research JHYRAF, Vol. 23, No. 4, p 359-377, 1985. 8 fig, 6 ref, append.

Descriptors: *Mathematical models, *Model studies, *Nonuniform flow, *Sediment transport, *Suspended sediments, *Unsteady flow, Entrainment, Hydrodynamics, Mass balance, Mathematical studies, Model testing.

A model for suspended-sediment transport in unsteady and non-uniform flow was derived. In this model, the vertical dimension was eliminated by means of an asymptotic solution. The resulting depth-integrated model was tested for unidirectional flow cases. If the mass-balance equation is depth averaged, the process of vertical readjustment of concentration profiles, arguably the most important mechanism involved, is obscured and replaced by an empirical or semi-empirical entrainment function. The verification of an entrainment function usually has to be done indirectly. Thus, there was a need to develop other approximate solutions for the mass-balance equation based on more explicit, easily-verifiable assumptions. The adjustment of the concentration distribution was formulated in terms of similarity profiles, including the deviation from local equilibrium. The coefficients of the similarity profiles depend on the depth-averaged concentration and its horizontal derivatives. Thus, for a vertically two-dimensional situation, the equations to be solved were reduced to one-dimensional. The resulting model can be used together with the depth-averaged hydrodynamic equations in large regions. It is believed that this solution will allow the gap between the depth-averaged solutions and the full two-dimensional solutions to be bridged. The asymptotic approach yields equations that can be written in terms of depth-averaged quantities and has the potential for extension to a third dimension. This model could not be verified extensively, but a comparison with a full two-dimensional approach indicated that reasonable results were obtained. A reasonably-successful indirect test was done by reproducing an experiment for the siltation of a trench. (Stoehr-PTT)
W91-00033

CONCENTRATION OF VERY FINE SILTS IN A STEADY VORTEX.
Colorado State Univ., Fort Collins.
P. Y. Julien.
Journal of Hydraulic Research JHYRAF, Vol. 24, No. 4, p 255-264, 1986. 5 fig, 11 ref.

Descriptors: *Particle size, *Sediment concentration, *Sediment transport, *Silt, *Suspended sediments, *Vortices, Diffusion, Fluid mechanics, Hydraulics, Particulate matter, Sediment sorting.

The presence of fine sediment particles in a steady horizontal vortex was examined theoretically and experimentally. Starting from an homogeneous mixture, particles denser than the surrounding fluid are moved outside of the vortex core by centrifugal action. As a sediment concentration gradient gradually builds up across the vortex, a diffusive flux opposite to the centrifugal flux is induced. Equilibrium is reached when the two fluxes are equal. Under steady state conditions, the sediment concentration profiles of fine particles in suspension were theoretically derived and plotted using dimensionless scales. Preliminary experiments verified the theoretical profiles. Experimental evidence supports the assumption that the diffusion coefficient remains constant throughout the vortex. (Author's abstract)
W91-00035

GEOCHEMICAL STUDY OF SEDIMENT CONTAMINATION IN NEW BEDFORD HARBOR, MASSACHUSETTS.
Environmental Protection Agency, Narragansett, RI. Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W91-00043

GEOMORPHOLOGICAL EFFECTS OF CATASTROPHIC FLOODING ON A SMALL SUBTROPICAL ESTUARY.
Council for Scientific and Industrial Research, Congella (South Africa). Estuaries and Coastal Processes Programme.
J. A. G. Cooper, T. R. Mason, J. S. V. Reddering, and W. K. Illenberger.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 1, p 25-41, February 1990. 9 fig, 3 tab, 42 ref.

Descriptors: *Estuaries, *Geomorphology, *Historic floods, *Sediment erosion, *Sedimentation, *Subtropic zone, Annual floods, Bed load, Sediment transport, South Africa, Tidal prism.

The Mgeni Estuary is situated on the east coast of South Africa. Tidal salinity changes commonly extend 2.5 km upstream from the mouth. The subtropical climatic regime causes seasonal flooding, the geomorphological effects of which are increased by a steep river gradient. A 120-150 year flood event during September 1987, with an estimated peak discharge of 10800 cumecs, resulted in the erosion of 1.86 million cu m of sediment from the estuary. The normal high tide volume of the estuary (0.35 million cu m) increased to 1.85 million cu m after the flood. The post flood intertidal volume (tidal prism) of the estuary was 0.43 million cu m compared to 0.19 million cu m before the event. The nature and extent of the erosion in the estuary was controlled by the composition of the estuary banks and bed material. Gravel and sand substrates were preferentially eroded from the estuary bed before the cohesive bank materials were undercut in sections of the estuary. Mud and fine sand were deposited on overbank areas when the flood waned and a lag of coarse sand and gravel was produced on the estuary bed. Approximately 46% of the bedload sediment supplied to the estuary since 1917 was retained in the estuary until the 1987 flood. The remainder was transported through the system and into the Indian Ocean. Results show that catastrophic floods play an important role in sedimentation in small estuaries. (Author's abstract)
W91-00049

EXPERIMENTAL STUDY OF COMPLEX RESPONSE IN RIVER CHANNEL ADJUSTMENT DOWNSTREAM FROM A RESERVOIR.
Academia Sinica, Beijing (China). Inst. of Geography.
J. Xu.
Earth Surface Processes and Landforms ESPLDB, Vol. 15, No. 1, p 43-53, February 1990. 5 fig, 9 ref.

Descriptors: *Channel morphology, *Channel stability, *Dam effects, *Geomorphology, *River forecasting, *River mechanics, Boundary conditions, Equilibrium, River systems, Sediment discharge.

An experimental study is described which attempts to reveal the complex response process of river channel adjustment downstream from a reservoir. A descriptive model was established which identifies three adjustment stages. In stage I following the change of water and sediment input, the width-depth ratio of the river channel (w/d) and the river channel gradient (s) both decrease, but the river channel sinuosity (r) increases. In stage II, because of feedback from the changing boundary conditions, w/d starts to increase, r decreases, and the rate of gradient decrease becomes very slow. In stage III, equilibrium is reestablished, w/d, r, and s tend toward constant values, and the system recovers its stable state. (Author's abstract)
W91-00050

BED FORM RESISTANCES IN OPEN CHANNEL FLOWS.
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00063

DIMENSIONLESS ANALYTICAL SOLUTIONS FOR DAM-BREACH EROSION.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W91-00069

ONE-DIMENSIONAL MODEL FOR THE TRANSPORT OF A SEDIMENT MIXTURE IN NON-EQUILIBRIUM CONDITIONS.
Trento Univ. (Italy).
A. Armanini, and G. di Silvio.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 3, p 275-292, 1988. 4 fig, 27 ref.

Descriptors: *Bed load, *Erosion rates, *Mathematical models, *Model studies, *Sediment transport, *Suspended load, Sedimentation, Streamflow.

The numerical simulation of erosion-deposition processes in rivers presents a number of problems of a conceptual nature, including the differences in behavior of bedload and suspended load. Non-stationary one-dimensional continuity equations of each granulometric class of sediments were written for the water stream (suspended transport), the bottom layer (bedload transport), and the mixing layer below the bottom surface. Proper closure equations were introduced to express the transversal sediment fluxes between these three layers, accounting for the different adaptation length of each grain size class. The model is able to address the lag between the suspended transport and the transport capacity of the stream, as well as the lag between the actual grainsize composition of the streambed and the streambed composition when equilibrium with the transport is attained. A number of examples are given, showing the importance of non-equilibrium for non-uniform particles in erosion-deposition processes at a short time scale. (Author's abstract)
W91-00070

WATER WAVES GENERATED BY DISTANT LANDSLIDES.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W91-00071

COMPREHENSIVE GENERALIZED STUDY OF SCOUR AT CANTILEVERED PIPE OUTLETS.
Agricultural Research Service, Stillwater, OK. Water Conservation Structures Lab.
For primary bibliographic entry see Field 8B.
W91-00072

CONVERSION OF BRAIDED GRAVEL-BED RIVERS TO SINGLE-THREAD CHANNELS OF EQUIVALENT TRANSPORT CAPACITY.
Canterbury Regional Council, Christchurch (New Zealand).
G. A. Griffiths.
Journal of Hydrology (New Zealand) JLHYAD, Vol. 28, No. 1, p 63-75, 1989. 4 fig, 1 tab, 27 ref.

Descriptors: *Bed load, *Braided streams, *Channel morphology, *Erosion rates, *Mathematical

models, *River training, *Sediment transport, *Streamflow, Channel flow, Mannings equation, Sedimentation.

A set of design equations was developed for determining the characteristics of a single-thread gravel-bed channel equivalent in water and bedload transport capacity to a given braided gravel-bed river or stream. The main components of the set are the Meyer-Peter and Muller formula for bedload transport and the Manning formula for flow resistance. In the specification of the design problem, water discharge and sediment size are always assumed known in the single-thread channel along with at least two of width, depth, bedslope, gravel discharge and resistance coefficient. For design cases the set was shown to replicate the behavior of small-scale braided sand-bed streams with steady flow, as well as producing results and predictions in accord with field observations on braided gravel-bed rivers. A procedure is illustrated for a braided to single-thread conversion in natural rivers where water and gravel discharges vary with time. It is founded on the assumption of equivalence of transported load over time, that is, reaches in a braided state, when converted to a single-thread state, discharge similar gravel loads over periods of 5-10 yr or longer. As a corollary the method provides a starting point for theoretical analysis of changes in channel sediment storage in gravel-bed rivers. (Author's abstract)
W91-00078

RECONSTRUCTION OF THE RECENT FLOW HISTORY OF A BRAIDED GRAVEL RIVER.
Canterbury Univ., Christchurch (New Zealand). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-00079

STREAM-CHANNEL INCISION FOLLOWING DRAINAGE-BASIN URBANIZATION.
King County Basin Planning, Seattle, WA.
For primary bibliographic entry see Field 4C.
W91-00082

STORMFLOW AND SEDIMENT LOSS FROM INTENSIVELY MANAGED FOREST WATERSHEDS IN EAST TEXAS.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 4C.
W91-00087

TEMPORAL LAG EFFECT IN BED LOAD SEDIMENT TRANSPORT.
Willing and Partners, Canberra (Australia).
B. C. Phillips, and A. J. Sutherland.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 1, p 5-23, 1990. 7 fig, 3 tab, 30 ref, append.

Descriptors: *Bed load, *Model studies, *Sediment transport, *Streamflow, *Temporal lag, Floods, Sediment-carrying capacity, Streambeds.

Temporal lag effects, which are viewed as the inability of an alluvial system to respond immediately to changing flow conditions, were investigated under bed load sediment transport conditions. A temporal lag model was formulated from an analysis of the derived bed load transport rated from a series of instantaneous stepped flow non-equilibrium transport experiments. The temporal response of the alluvial system was characterized by a single variable, the equivalent steady flow rate. An impulse model was then used to develop a general temporal solution. The performance of the temporal lag model was tested by comparing measured and predicted flow depths and sediment yields from four series of inclined stepped discharge non-equilibrium transport experiments. A comparison of measured and predicted sediment hydrographs and sediment yields for three triangular flood waves was undertaken and it was concluded from both series of comparisons that the temporal lag model was well able to predict the temporal variation of bed roughness and sediment transport capacity under nonsteady flow conditions. (Mertz-PTT)
W91-00093

PREDICTION OF ENTRAINMENT CONDITIONS FOR NONUNIFORM, NONCOHESIVE SEDIMENTS.
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
C. S. James.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 1, p 25-41, 1990. 5 fig, 1 tab, 52 ref.

Descriptors: *Bed load, *Entrainment, *Model studies, *Sediment transport, Computer models, Sediment analysis, Sediment distribution, Sediments, Streamflow, Tractive forces.

The entrainment of sediment particles by flowing water is a very important process in sediment dynamics. Many sediment transport models are expressed in terms of a critical value of boundary shear stress at which particles are just able to move. Reliable application of these models depends on accurate specification of this critical shear stress. Results are not useful, however, where sediments are nonuniform and the behavior of particles with distinct size, shape or density characteristics in the mixture need to be described. A general model was established for predicting entrainment conditions for nonuniform, noncohesive sediments. The model is based on an analysis of the moments of forces acting on a particle at the condition of incipient motion. Particle geometry and packing arrangement are accounted for as well as variations of near bed flow velocity and drag and lift coefficients for a wide range of flow conditions. Model predictions agree well with laboratory and field measurements for uniform sediments and for protrusion and relative size effects. (Mertz-PTT)
W91-00094

INFLUENCE OF SAND OR GRAVEL ON THE EROSION OF COHESIVE SEDIMENT.
Queen's Univ., Kingston (Ontario).
J. W. Kamphuis.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 1, p 43-53, 1990. 9 fig, 2 tab, 13 ref.

Descriptors: *Channel erosion, *Cohesive sediments, *Erosion, *Stream erosion, Bottom sediments, Canada, Clays, Erosion rates, Gravel, Lake Erie, River sediments, Sand, Sediment transport, Sediments, Streambeds, Streamflow.

The erosion of consolidated cohesive sediments which make up some river beds and shorelines has long been considered a complex process, involving the structural as well as the physicochemical properties of the eroding cohesive sediment. Three disparate examples were studied in the field and the laboratory, these included: (1) The construction of artificial islands in the Mackenzie River at Norman Wells in the Canadian Northwest Territories. These islands were constructed on a river bottom, consisting of a consolidated clay material and could be subjected to currents of up to 5 m/sec, resulting from ice jam release in spring; (2) The North Shore of Lake Erie consists of eroding glacial till bluffs. An extensive study was initiated to determine what influences the rate of erosion of such a shoreline; and (3) Four series of tests were performed on undisturbed samples of lacustrine clays found at four Ontario bridge crossing sites. It was found that the erosion of consolidated cohesive soils is very much a function of the transport properties of even sparse amounts of granular material overlying the cohesive soil or carried by the eroding stream. Since erosion of consolidated cohesive sediments by clear water is a complex function of the characteristics of the cohesive sediment and not readily understood, while sediment transport of granular material is relatively much better known, this concept greatly simplifies understanding of erosion of a cohesive bed. (Mertz-PTT)
W91-00095

WEAKLY DEPOSITING TURBIDITY CURRENT ON A SMALL SLOPE.
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
S. Altinakar, W. H. Graf, and E. J. Hopfinger.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 1, p 55-80, 1990. 18 fig, 1 tab, 25 ref.

Descriptors: *Sedimentation, *Turbidity currents, *Water currents, Gravity currents, Salinity currents, Sedimentation effects, Sedimentation rates, Sediments, Streamflow.

Turbidity currents are defined as gravity currents, where the denser phase contains settling granular material. The influence of a small slope and weak sedimentation on the behavior of non-conservative turbidity current heads were experimentally investigated. Experiments were carried out on a slope ranging between 0-2.1 degrees with two different sediments to get a reasonably wide range of the ratio of fall velocity of particles to the velocity of the head. The limiting case when the fall velocity of particles equals 0 (conservative gravity current) was investigated by a series of saline gravity current experiments. The importance of sedimentation on the head behavior was demonstrated by plotting the variation of the head velocity against the slope, for different current types. By showing that a relative submergence ratio, varying along the flume causes a slight increase in the head velocity for saline gravity currents, attention is drawn to a possible scale effect in laboratory modelling of the gravity current phenomena, which is often neglected. The experimental data showed that the downslope head growth rate is increased by sedimentation. Since the Reynolds numbers are sufficiently high, the dimensionless nose heights fluctuate about 0.14. (Mertz-PTT)
W91-00096

DESIGN OF SETTLING BASINS.
Indira Gandhi National Open Univ., New Delhi (India).
R. J. Garde, K. G. Ranga Raju, and A. W. R. Sujudi.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 1, p 81-91, 1990. 9 fig, 1 tab, 9 ref.

Descriptors: *Canals, *Sediment-carrying capacity, *Settling basins, Canal design, Channel flow, Flow pattern, Sediment discharge, Sedimentation, Sediments, Streamflow.

It is an accepted practice in canal design that sediment in excess of the carrying capacity is either excluded at the head works or ejected from the canal little downstream from the head. The settling basin is a popular type of ejector which is well suited for the removal of fine material. Experiments were carried out in the laboratory concerning the efficiency of settling basins. Experiments were conducted for subcritical flow under steady conditions. The rate of injection of material as sediment load for all the runs was ensured to be equal to or less than the capacity of the channel to transport sediment. The limit was also checked visually while conducting the experiments by ensuring that significant deposition of sediment did not occur along the channel reach. The data indicated that the existing methods of settling basin design are not satisfactory. Analysis of all the available data has led to a new relationship for the efficiency. The parameters length of settling basin/depth of flow in the settling basin and fall velocity of the sediment in clear water/shear velocity in the settling basin, were found to govern the efficiency. (Mertz-PTT)
W91-00097

STATISTICAL ZONATION OF SEDIMENT SAMPLES USING RATIO MATCHING AND CLUSTER ANALYSIS.
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
D. J. Poulton.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 379-404, November 1989. 6 fig, 9 tab, 15 ref.

Descriptors: *Chemical stratification, *Cluster analysis, *Path of pollutants, *Port Hope, *Sediment contamination, *Statistical analysis, Canada, Great Lakes, Hamilton Harbor, Lake sediments,

Pollution load, Statistical methods, Water pollution sources.

Contaminants in sediments have long been recognized as a significant problem in polluted areas, such as Areas of Concern in the Great Lakes. Full problem definition in any polluted area thus requires a knowledge of the role of sediments as a component in the overall ecosystem. A zonation technique for sediment samples based upon contaminant ratios of a series of samples utilizes the statistical technique of ratio matching. The technique is based on the fact that sediment samples of common origin will tend to have similar ratios of concentrations of trace pollutants such as heavy metals and PCBs, despite dilution by variable amounts of inert materials such as silica or calcite. Comparisons of these ratios between individual samples yields a matrix of similarity coefficients, which are then analyzed by a hierarchical agglomerative cluster analysis procedure, which uses average linkage and complete linkage clustering methods. Sediment samples of similar origin will tend to group together in a single cluster, whereas samples influenced by unique factors such as a transport pattern or proximity to point source discharges will appear as separate individual clusters. The results of application of this methodology to Great Lakes samples from Hamilton Harbour and Port Hope document the value of the method in defining uniquely impacted zones in contaminated areas. The Hamilton Harbour data are characterized by one large cluster representative of all stations in the main basin of the harbor plus several other clusters representing areas impacted by point sources or exchange with Lake Ontario and Cootes Paradise. The Port Hope data produced clusters representative of the depositional environment of the turning basin, the transitional environment of the river and west slip, and the high energy nearshore zone, plus a cluster showing the impact of the major cooling water discharge for the Eldorado uranium refinery. (Tappert-PTT)
W91-00137

MENU OF COUPLED VELOCITY AND SEDIMENT-DISCHARGE RELATIONS FOR RIVERS.
Pima County Dept. of Transportation and Flood Control, Tucson, AZ.
M. F. Karim, and J. F. Kennedy.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 8, p 978-996, August 1990. 2 fig, 4 tab, 34 ref.

Descriptors: *Channel morphology, *Computer models, *Flow velocity, *Hydraulic engineering, *Model studies, *Sediment discharge, *Sediment transport, Channel improvement, Numerical analysis, Regression analysis, River beds, Water depth.

Nowhere in the field of hydraulics have computers' impacts been more evident and pervasive than in river engineering, and in particular in the prediction via numerical simulation of long-term, large-distance responses of alluvial rivers to alterations of their channels, or of their hydrologic or sediment-transport regimes. Nonlinear multiple-regression analysis was used to derive relations among the velocity, sediment discharge, bed-form geometry, and friction factor of alluvial rivers. A data base comprising 339 river flows and 608 flume flows was used in this analysis. A hierarchy of formulations involving progressively more interdependencies among velocity, depth, sediment discharge, and bed-form geometry was developed. Procedures have been devised for computing velocity-rating and sediment-rating curves, and for preparing depth-discharge relations for streams with strongly discontinuous rating curves. Rating curves were calculated for four rivers, and computed depths and velocities for two others. The accuracies of the different methods were evaluated in terms of the mean normalized errors of predicted friction factors, depths, velocities, and sediment discharges. It was concluded that these formulations yield velocity-rating and sediment-rating curves that are as reliable as is permitted by the accuracy of the available data, which is limited by, among other things, the inherent short-term temporal variability of streamflow properties. (Author's abstract)
W91-00149

DESIGN OF STABLE ALLUVIAL CHANNELS.
Kuwait Inst. for Scientific Research, Safat. Hydraulics and Coastal Engineering Group.
M. M. Abou-Seida, and M. Saleh.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 4, p 433-446, 1987. 6 fig, 3 tab, 6 ref.

Descriptors: *Alluvial channels, *Canal design, *Channel morphology, *Channel stability, *Hydraulic engineering, *Model studies, *Sediment transport, Channel flow, Channel scour, Computer models, Flow resistance, Model testing.

For a channel in an alluvial material, stable conditions are achieved through the adjustment of three factors: channel width, channel depth, and channel slope. The three factors, to each of which nature gives definite equilibrium values to suit definite imposed conditions, require three equations. The imposed conditions are the rate of flow and the rate of sediment transport to be carried through the channel. The channel is considered stable if the sediment admitted to it is sufficient to balance the scour due to the bed movement. Two equations are available by means of which the proper dimensions of a stable channel can be obtained together with the channel longitudinal slope; the Liu-Hwang flow resistance equation was coupled with the Einstein-Brown sediment transport expression to develop the live-bed concept/model. The model was developed to predict the bed width, water depth, and longitudinal slope for an alluvial channel for a pre-assigned water flow, sediment discharge, median diameter of bed particles, and temperature. This model was verified using field data from Pakistan, India, the United States, and Egypt. A computer program was developed to facilitate the calculation procedure; limitations for flow regime and the shape factor were imposed to render the design to practical conditions. (Fish-PTT)
W91-00154

LONGSHORE-TRANSPORT MODEL FOR SOUTH INDIAN AND SRI LANKAN COASTS.
National Inst. of Oceanography, Panaji (India).
For primary bibliographic entry see Field 2L.
W91-00176

2-D BED EVOLUTION IN NATURAL WATERCOURSES: NEW SIMULATION APPROACH.
Energoprojekt, Belgrade (Yugoslavia).
M. Spasojevic, and F. M. Holly.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 116, No. 4, p 425-443, July/August 1990. 7 fig, 27 ref. U.S. National Science Foundation Grant MSM-85-166.

Descriptors: *Alluvial channels, *Bed load, *Channel morphology, *Model studies, *Natural watercourses, *Sediment transport, *Unsteady flow, Coastal waters, Coasts, Computer models, Estuaries, Finite difference methods, Iowa, Mathematical models, Reservoirs, Simulation analysis, Suspended load.

A new mathematical formulation was established for two-dimensional (plan view) unsteady water flow, sediment transport, and bed evolution in natural watercourses such as reservoirs, estuaries, and coastal waters, where depth averaging is appropriate. Sediment mixtures in natural watercourses were represented through a suitable, and unlimited, number of discrete size classes, any of which may be subject to either suspended load or bed load transport (or both) depending on prevailing local hydraulic conditions. Governing equations for water and sediment were transformed (completely) into curvilinear coordinates and then depth-averaged, when appropriate. The system of governing sediment equations at a computational point was solved in a new implicit, finite difference, fully coupled manner. Furthermore, the sediment equations were coupled with the water flow in an iterative manner in order to account for the feedback between the flow field and changes in both bed elevation and bed-surface size distribution. The mathematical formulation and associated numerical solution, incorporated into the new MOBED2 computational code, were tested through simulation of mobile-bed dynamics in the Coralville Reservoir on the Iowa River, Iowa. Initial proof-of-concept tests confirm the feasibility of the new approach by reproducing the proper qualitative behavior of the overall modeling concept. (Author's abstract)
W91-00177

SEDIMENT AND THE ENVIRONMENT.
Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. 218p. Edited by R. F. Hadley, and E. D. Ongley.

Descriptors: *Agricultural runoff, *Erosion control, *Path of pollutants, *Sediment transport, *Sediments, *Water pollution sources, Construction, Drainage, Mining, Nonpoint pollution sources, Sediment analysis, Sediment contamination, Simulation analysis, Waste disposal.

The proceedings of a symposium on sediment and the environment held in Baltimore, Maryland on 17-18 May 1989 are presented. The symposium was part of the Third Scientific Assembly of the Association of Hydrological Sciences (IAHS) and was organized by the IAHS International Commission on Continental Erosion. The papers in this volume are divided into four categories: (1) sediment-associated transport of contaminants in non-point pollution and impacts on hydrologic systems (12 papers); (2) erosion control for mining, construction, and waste disposal activities (4 papers); (3) time lag in the movement of sediments through drainage networks (four papers); and (4) modelling of agricultural runoff pollution and physical habitat simulation (3 papers). (See W91-00281 thru W91-00303) (MacKeen-PTT)
W91-00280

NITROGEN AND PHOSPHORUS IN ERODED SEDIMENT FROM CORN AND SOYBEAN TILLAGE SYSTEMS.
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W91-00281

ROLE OF SEDIMENT IN METOLACHLOR TRANSPORT FROM AGRICULTURAL FIELDS.
Trent Univ., Peterborough (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W91-00282

TRANSPORT OF MINE TAILINGS AS SUSPENDED SEDIMENT IN THE BELLE FOURCHE RIVER, WEST-CENTRAL SOUTH DAKOTA, USA.
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-00283

RATE OF SEDIMENTATION AND GEOCHEMISTRY OF SOUTHEASTERN HUDSON BAY, CANADA.
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
G. Biksham, and B. d'Anglejan.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p. 27-36, 2 fig, 7 tab, 15 ref.

Descriptors: *Geochemistry, *Sediment analysis, *Sedimentation rates, *Suspended sediments, Canada, Carbon, Hudson Bay, Nitrogen, Seasonal variation, Sediment transport, Silica, Silicon.

Suspended particulate matter (SPM) of Hudson Bay was estimated by collecting 60 samples at

three stations and four different depths. The mean SPM in the study area was 0.642 mg/L. The sediments collected in traps indicated that the rate of accumulation increased with depth. Seasonal variation provided a rate that was 2 to 4 times higher during the month of May. The rate of sedimentation estimated by Pb-210 data was 51 to 63 mm/100 yr, which is in general agreement with the trap data. Carbon and nitrogen together constituted more than 50% of SPM. In the trap sediments, carbon ranged from 17 to 38% and nitrogen from 1.6 to 6.3%. In underlying sediments, the carbon was very uniform at a mean 1.96% of total, of which more than 85% was in the organic fraction. Elemental analysis on core sediments showed uniform bulk chemistry. High Si/Al ratio indicated that the source of sediments to the Bay may include other than fluvial transport. The amorphous silica content in the sediments ranged from 0.77 to 2.36%, which is 2 to 8% of total silica; in trap sediments amorphous silica content was more than 6%. Size studies indicated the breakdown of SPM, resulting in collection of relatively more fine sediments in the deeper traps. A gradual increase of sand fraction in the last 1000 years indicates a change in supply of the sediments to the Hudson Bay. (See also W91-00280) (Author's abstract)
W91-00284

SEDIMENT-ASSOCIATED TRANSPORT AND REDISTRIBUTION OF CHERNOBYL FALL-OUT RADIONUCLIDES.
Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W91-00285

CROSS-SECTIONAL VARIABILITY IN SUSPENDED SEDIMENT AND ASSOCIATED TRACE ELEMENT CONCENTRATIONS IN SELECTED RIVERS IN THE US.
Geological Survey, Denver, CO. Water Resources Div.
A. J. Horowitz, F. A. Rinella, P. Lamothe, T. L. Miller, and T. K. Edwards.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 57-66, 4 tab, 7 ref.

Descriptors: *River sediments, *Sampling, *Sediment analysis, *Sediment chemistry, *Sediment sampler, *Suspended sediments, *Trace elements, Arkansas River, Colorado, Cowlitz River, Cross-sections, Emission spectrometry, Kelso, Portland, Sediment concentration, Variability, Washington.

Suspended sediment samples from the Arkansas River at Portland, Co and Cowlitz River at Kelso, WA were analyzed for physical and chemical properties. Particle surface area and suspended sediment concentration were determined for each sample; trace metal concentrations were measured by direct-reading emission spectrometry. The results indicated that there were substantial differences in suspended sediment concentrations and possibly in some associated trace element concentrations depending on whether depth-integrated, point, or pumping samplers were used. In addition, the data from time-series, depth-integrated sampling indicated that there were substantial short-term (on the order of 30 min) spatial variations in suspended sediment concentrations. Despite this, major element concentrations were remarkably stable spatially and temporally. Trace element concentrations were stable; however, occasional spatial and temporal variations may occur. (See also W91-00280) (MacKeen-PTT)
W91-00287

CROPPING SYSTEMS EFFECTS ON RUNOFF, EROSION, WATER QUALITY, AND PROPERTIES OF A SAVANNA SOIL AT ILORIN, NIGERIA.
Ohio State Univ., Columbus. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W91-00288

SOIL EROSION AND FLOODPLAIN SOIL POLLUTION: RELATED PROBLEMS IN THE GEOGRAPHICAL CONTEXT OF A RIVER BASIN.
Utrecht Rijksuniversiteit (Netherlands). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W91-00289

CASE STUDY OF APPROACHES FOR DETERMINING DIFFUSE SUSPENDED SEDIMENT SOURCES AND PROCESSES.
Alberta Research Council, Edmonton. Resource Technologies Dept.
H. R. Hudson.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 85-94, 1 fig, 6 ref.

Descriptors: *Data acquisition, *Sediment analysis, *Sediment transport, *Sediment yield, *Suspended sediments, Aerial photography, Alberta, Analytical methods, Canada, Erosion, Oldman River, River sediments.

Methods of differentiating sources and processes governing suspended sediment transport in the 4400 square km Upper Oldman River basin, southwest Alberta, were evaluated. Long term records showed that the average annual suspended sediment yield of 275,000 tons was largely transported in a period of days during the spring freshet. The majority of this material is thought to be derived from channel and near channel (riparian) sources from a short reach of the river in the Cardston Plains. Sediment sources and process interferences were determined in a static approach by (a) reconnaissance survey of sediment sources (aerial photograph interpretation and site surveys); (b) quantification of sediment sources (sediment budgets for sub-basins and erosional volume estimates of selected sites from sequential aerial photos); and (c) examination of spatial variations in sediment attributes (size distribution, lithology, cesium content). A combination of these approaches is required to obtain a reasonable assessment of the sediment sources and processes. (See also W91-00280) (Author's abstract)
W91-00290

FLOCCULATION OF SUSPENDED SOLIDS IN SOUTHERN ONTARIO RIVERS.
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
I. G. Droppo, and E. D. Ongley.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 95-103, 3 fig, 15 ref.

Descriptors: *Flocculation, *Path of pollutants, *Rivers, *Sampling, *Sediment analysis, *Suspended solids, Analytical methods, Bacteria, Canada, Microscopy, Oakville Sixteen Mile Creek, Ontario, Storms.

Suspended solids play a primary role in fluvial transport of hydrophobic contaminants. Evidence suggests that in many rivers primary particles are frequently transported as flocs within the aquatic medium. The changes in floc size and shape between two sampling sites during the summer low flow period and in a storm event were examined for the Oakville Sixteen Mile Creek in southern Ontario, Canada. Samples were collected directly in settling chambers and flocs were analyzed by microscopy, photography and digitization. Bacteria associated with flocs were quantitated by epifluorescent microscopy after 1.0 micrometer filtration. While there were fewer flocs than primary particles in suspension (flocs composed 10-27% of the total number of particles), the flocs comprised 92-98% of the total suspended solid volume. There was no significant difference in floc size between sampling sites, one of which was in a rural, forested area and the other in the harbor of an urban area. Mean floc area decreased from 173.5 sq micrometers during a dry period to 94.97 sq micrometers after a high intensity rainstorm of 45 minutes followed by light rain. It was concluded that while the digitizing method has some limitations, especially for grain size distributions, it is useful in evaluating physical and biological controls over flocculation. (See also W91-00280) (MacKeen-PTT)
W91-00291

HYSTERESIS AND NONLINEARITY OF DISCHARGE-SEDIMENT RELATIONSHIPS IN THE ATCHAFALAYA AND LOWER MISSISSIPPI RIVERS.
Louisiana Geological Survey, Baton Rouge. Coastal Geology Section.
J. Mossa.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 105-112, 3 fig, 1 tab, 15 ref.

Descriptors: *Atchafalaya River, *Data interpretation, *Flow discharge, *Hysteresis, *Mississippi River, *River sediments, *Sediment transport, *Statistical analysis, Discharge measurement, Louisiana, Regression analysis, Sand, Sediment analysis, Sediment concentration, Silt-clay, Suspended sediments.

The Atchafalaya and lower Mississippi Rivers in south Louisiana are two of the largest rivers in the United States and are an important source of fresh water and sediment for the Louisiana coastal zone. The physical relationships between discharge and sediment in these rivers were examined by linear least squares regression analysis of discharge versus sediment characteristic (concentration, sand concentration, silt-clay concentration, suspended sediment load and percentage sand). Several relationships between discharge and sediment in the Atchafalaya and Mississippi Rivers emerged: (1) hysteresis effects were pronounced, especially during high discharge years where the sediment concentration and load maxima preceded discharge maxima by several months and showed decreased sediment concentrations by the time discharge peaks; (2) the silt-clay and sand components of the suspended sediment operated distinctively; (3) the total suspended sediment concentration and the suspended silt-clay concentration followed quadratic power relationships; and (4) downstream differences in discharge-sediment relationships existed. (See also W91-00280) (MacKeen-PTT)
W91-00292

PLACER MINING OPERATIONS AND MODIFICATIONS OF THE PHYSICAL CHEMICAL NATURE OF THE WATERS OF THE RIO KAKA DRAINAGE BASIN (ANDES, BOLIVIA).
Office de la Recherche Scientifique et Technique Outre-Mer, La Paz (Bolivia).
For primary bibliographic entry see Field 5B.
W91-00293

SOIL EROSION IN THE YELLOW RIVER BASIN AND ITS IMPACTS ON RESERVOIR SEDIMENTATION AND THE LOWER YELLOW RIVER.
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China). Dept. of Sedimentation Engineering.
Q. Zeng, and W. Zhou.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 123-130, 4 fig, 6 ref.

Descriptors: *Erosioh control, *River sediments, *Sediment control, *Sedimentation, *Soil erosion, *Yellow River, Bed load, Channel morphology, China, Flood control, Reservoir sediments, Runoff, Silting, Structural engineering.

The Yellow River in China has a drainage area of 750,000 sq km and a total length of 5464 km and is known for its enormous sediment load. The features of soil erosion and its impacts on reservoir sedimentation and channel deposition of the lower Yellow River were examined. Long term data

reflect an annual precipitation for the Yellow River basin of 478 mm, an annual runoff of 46.4 x 10(9) cu/m and an annual sediment load of 1.56 x 10(9) tons (at Sanmenxia Station). Comparing the time periods from 1970-1984 and from 1950-1969, there were decreases in runoff and sediment load of 14.8% and 33.7%, respectively. While part of the decrease is ascribed to decreased precipitation in the more recent period, the water and soil conservation engineering works were also thought to have alleviated the problem of soil erosion. For some reservoirs on the main branch of the Yellow River, 50-87% of their storage capacities were lost due to sedimentation within 5 to 7 years. The tremendous sedimentation on the flood plain and channel bed results the river bed of the Lower Yellow River rising at a rate of 0.10-0.15 m/yr. Flood prevention is the most important problem in the area, with embankment breach occurring twice in three years historically. (See also W91-00280) (MacKeen-PTT)
W91-00294

COST IMPACTS OF SEDIMENTS IN SOUTH AFRICAN RIVERS.
Hydrological Research Inst., Pretoria (South Africa).
E. Braune, and U. Looser.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 131-143, 1 fig, 8 tab, 40 ref.

Descriptors: *Cost analysis, *Drainage basins, *Erosion rates, *Sedimentation, *Sediments, *Soil erosion, *South Africa, Agriculture, Cropland, Environmental effects, Reservoir capacity, Reservoir sediments, River sediments, Soil conservation, Water treatment.

Soil erosion is a serious problem in South Africa. Erosion rates have increased considerably due to human impacts. Off-site damages as a result of high sediment yields from drainage basins are discussed in terms of loss of reservoir storage capacity, damage to agricultural land and crops, enhanced water treatment costs and impacts on the aquatic environment. From a hydrographic survey database for 170 reservoirs, an average storage loss rate of 0.35% per year was indicated. The total off-site cost impact, excluding environmental damage, was estimated at R90 million per year (R1 = U.S. $0.40). This is an order of magnitude higher than the annual national expenditure on soil conservation. (See also W91-00280) (Author's abstract)
W91-00295

LONG AND SHORT-TERM EPISODIC STORAGE AND REMOVAL OF SEDIMENT IN WATERSHEDS OF SOUTHWESTERN WISCONSIN AND NORTHWESTERN ILLINOIS.
Wisconsin Univ.-Madison. Dept. of Geography.
J. C. Knox.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 157-164, 4 fig, 16 ref. NSF Grant EAR-8707504.

Descriptors: *Agriculture, *Erosion rates, *Flood plain sediments, *Land use, *Sediment erosion, *Sediment transport, *Sedimentation rates, *Soil erosion, Dating, Flooding, Illinois, Mississippi, Mississippi Valley, River sediments, Slopes, Surface runoff, Watersheds, Wisconsin.

Average annual rates of erosion and sedimentation commonly are used to evaluate long-term movement and storage of sediment in watersheds. Average rates often poorly represent actual rates because changing environmental factors may dramatically alter surface runoff, flooding, and channel stability. Dating of historical, Holocene (postglacial), and late-Wisconsin (late glacial) hillslope and flood plain sediments in southwestern Wisconsin and northwestern Illinois indicated that rates of sediment erosion, storage, and transportation fluctuate episodically due to changing watershed environmental conditions. In the humid climate of the Upper Mississippi Valley, periods of sediment storage tend to be relatively slow and progressive whereas removal of sediment from storage tends to be episodic with short periods of dramatically high rates separating longer periods of relatively low rates. Historical erosion and sedimentation rates usually poorly represent long-term natural rates because of anthropogenic disturbance of land cover. The replacement of prairie and forest by agricultural land use in the Upper Mississippi Valley resulted in accelerated flood plain sedimentation that averages 30-50 cm deep on tributary flood plains and as much as 3-4 m deep on flood plains in lower reaches of main valleys near the Mississippi River. The use of lead and zinc trace metals associated with historical mining shows that decadal-scale average historical rates of overbank flood plain sedimentation range from about 0.3 cm/yr to 4.0-5.0 cm/yr and greatly exceed the average presettlement post-glacial flood plain vertical accretion rate of 0.02 cm/yr that was determined for radiocarbon dated alluvial deposits. (See also W91-00280) (Author's abstract)
W91-00297

CONSTRAINTS ON DURATION OF SEDIMENT STORAGE IN A WIDE, GRAVEL-BED RIVER, NEW ZEALAND.
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Geography.
J. B. Laronne, and M. J. Duncan.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 165-172, 4 fig, 2 tab, 11 ref.

Descriptors: *Alluvial channels, *Braided streams, *Channel storage, *River beds, *River sediments, *Sediment distribution, *Sediment load, *Sediment transport, Channel accretion, Channel scour, Gravel bed rivers, New Zealand, North Branch Ashburton River, River flow, Sediment storage, Streambeds.

The area of inactive zones in a braided gravel bed river (North Branch Ashburton River, New Zealand) shrinks as the magnitude and duration of competent flow events increase. In a narrower and aggrading reach the entire bed is activated by events that recur twice annually and bed material is stored by actual fill exceeding actual scour. In the wide, braided and stable reach, bed material is stored in bars and its residence time increases as bar height and bar width increase. The depth of bed activity also increases as event flow increases. Amouring of branch channel bed and banks is particularly noticeable in the wide reach; it is the main sedimentologic constraint on the residence time of bed material. (See also W91-00280) (Author's abstract)
W91-00298

SEDIMENT STORAGE AND MOVEMENT ON THE SOUTHERN HIGH PLAINS OF TEXAS AS INDICATED BY BERYLLIUM-TEN.
Geological Survey, Lakewood, CO.
W. R. Osterkamp.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 173-182, 3 tab, 25 ref.

Descriptors: *Beryllium, *Playas, *Sediment storage, *Sediment transport, *Sedimentation rates, *Tracers, Ephemeral lakes, Lake basins, Mathematical models, Soil erosion, Southern High Plains, Texas, Wind erosion.

The Southern High Plains is an area in which most runoff and water-entrained sediment collects and is stored in ephemeral-lake basins, or playas. Ponded playa water recharges the High Plains aquifer. Measured thicknesses and carbon isotope analyses of playa sediment lead to calculated rates of net playa deposition up to 0.48 m/1000 yr, of which 0.09 m/1000 yr is estimated as the maximum possible contribution due to slope-wash processes. Most other sediment movement, including fluxes in and from playa bottoms, is inferred to occur by eolian processes. Beryllium-10 (Be-10) is a naturally occurring cosmogenic radioisotope (half-life 1.5 Ma) of known accumulation rate with precipitation. Because Be-10 becomes tightly bound and concentrated on soil sediment, its movement and storage are closely related to those of sediment. By measuring inventories, accountings of Be-10 per unit area, at playa and interplaya sites, comparisons were made with the known accumulation rate. The comparisons suggest that wind erosion removes an average depth of 0.1 mm of sediment annually, and that deflation accounts for roughly 35 times as much sediment transport as does flowing water. Measured Be-10 concentrations with depth at playa and interplaya areas show significant transport of Be-10 into the unsaturated zone from playas; numerical modelling suggests that much of the Be-10 moves in solution, but movement on sediment through natural conduits may occur as well. The numerical model provides estimates of playa age, and suggests that those playas studied developed in late Pleistocene time. (See also W91-00280) (Author's abstract)
W91-00299

HILLSLOPE AND CHANNEL SEDIMENT DELIVERY AND IMPACTS OF SOIL EROSION ON WATER RESOURCES.
East Carolina Univ., Greenville, NC. Dept. of Geography and Planning.
J. D. Phillips.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 183-190, 1 tab, 23 ref.

Descriptors: *Model studies, *Sediment discharge, *Sediment transport, *Sediment yield, *Slopes, *Soil erosion, *Water quality, Drainage basins, Mathematical models, North Carolina, Upper Tar River, Water quality management, Water resources, Watershed management.

Total soil erosion is less important than the amount of sediment which is retained in stream channels, from a water quality perspective. A physical model for estimating channel sediment delivery ratios is proposed. The sediment delivery ratio (SDR) for a drainage basin is defined as sediment yield at the basin mouth divided by total upland erosion. A stream power based method is used for determining the channel SDR. The model requires two basic components: (1) the estimation of an SDR for the entire basin, via field measurements or estimates, empirical equations or nomographs, or simulation modeling; and (2) measurements or estimates of a reference discharge or associated hydraulic geometry at the basin mouth and at a number of locations upstream. The model was applied to the Upper Tar River basin in the lower Piedmont of North Carolina, with good agreement found for qualitative tests on watersheds where sediment erosion and transport patterns were relatively well known. (See also W91-00280) (MacKeen-PTT)
W91-00300

DEVELOPING ACCURATE AND RELIABLE SEDIMENT YIELDS.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 7C.
W91-00301

PHYSICAL HABITAT SIMULATION AND SEDIMENTATION.
National Ecology Center, Fort Collins, CO.
For primary bibliographic entry see Field 4C.
W91-00303

SPELEOLOGICAL PHENOMENA OF DINARIC KARST.
Institute for Karst Research, Postojna (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00322

KARST POLJES IN DINARIDES.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00323

REVIEW OF SOME SIGNIFICANT PONORS IN SINJSKO AND DUVANJSKO POLJES.
Institute of Geology, Zagreb (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00324

GUIDE FOR SELECTING MANNING'S ROUGHNESS COEFFICIENTS FOR NATURAL CHANNELS AND FLOOD PLAINS.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2E.
W91-00335

STORM RUNOFF AND ITS EFFECTS ON THE WATER QUALITY AND BOTTOM-MATERIAL QUALITY OF CEDAR CREEK, WEST-CENTRAL ILLINOIS, 1985-6.
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-00339

SIGNIFICANCE OF SEDIMENT TRANSPORT IN ARROYO DEVELOPMENT.
Geological Survey, Vancouver, WA. Water Resources Div.
D. F. Meyer.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Supply Paper 2349. 61p, 39 fig, 5 tab, 63 ref, 2 append.

Descriptors: *Arroyos, *Channel erosion, *Channel morphology, *Geomorphology, *Model studies, *Sediment transport, Bed load, Braided streams, Meanders, New Mexico, Particle size.

When bed material is predominantly sand, the channel pattern within initial arroyos is typically braided, and both arroyo walls are actively eroded. Alternate bars may form within single-thread, high-flow channels, but they are reworked during recessional flows, and the low-flow channel is again braided. With progressive arroyo widening, fine sand, silt, and clay carried in suspension are deposited across a flood plain within the wide arroyo, causing the channel to meander. This fine-grained arroyo development model is based on observations of arroyo development through time using physical models and interpretation of the channel and arroyo morphology and sedimentology during a short period along the Rio Puerco, New Mexico. Experimental investigations using physical models in which incised channels were monitored through time indicate that the rate of arroyo widening is dependent on the amount of bedload transported through a reach. This is documented by the relations between the rate of arroyo erosion and the observed sediment transport, the channel slope, the channel width and the channel width-to-depth ratio. When a small amount of bed material is being transported, arroyos do not widen whether they are narrow (arroyo width-to-depth ratios between 1.5 and 3.1), intermediate (between 2.5 and 4.8), or wide (greater than 4.9). Arroyo widening resumes when a larger supply of bed material is introduced. Arroyo widening decreases through time because with progressive increases of arroyo width, the frequency with which unstable channels within the arroyo impinge upon arroyo walls decreases. Arroyos become wider in a downstream direction in response to the cumulative effect of upstream sediment production. (Author's abstract)
W91-00346

LOCAL SCOUR AROUND BRIDGE PIERS.
Nanyang Technological Inst., Singapore.
Y. M. Chiew, and B. W. Melville.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 1, p 15-26, 1987. 7 fig, 2 tab, 13 ref.

Descriptors: *Bridge design, *Bridges, *Flow around objects, *Piers, *Scour, *Sediment erosion, Flow depth, Sediment size, Velocity of approach.

Local scour around cylindrical bridge piers in uniform, cohesionless sediment was investigated experimentally. Scour is defined as the removal of bed material by the erosive action of water. Three empirical functions which relate equilibrium scour depth with approach velocity, sediment size and flow depth were obtained. The variations of equilibrium scour depth with approach velocity show that the depth of scour decreases at velocities just above the threshold until it reaches the minimum at about twice the threshold velocity. Thereafter, it increases again until a maximum is reached at the transition flat bed condition. At still higher velocity, the equilibrium scour depth decreases due to the formation of antidunes. Both the effects of sediment size and flow depth were found to be independent of the stage of bed particle motion and the approach velocity. Adjustment factors for the effects of sediment size and flow depth were defined and evaluated. The equilibrium clear water scour depth is always < 2.3 times the pier diameter while the equilibrium live-bed scour depth is always < 2.0 times the pier diameter. In live-bed conditions the contribution to the total scour depth from bed features may be significant, especially in flow where the size of the bed features is large. (MacKeen-PTT)
W91-00397

PRELIMINARY ASSESSMENT OF THE POTENTIAL FOR USING CESIUM-137 TO ESTIMATE RATES OF SOIL EROSION IN THE LOESS PLATEAU OF CHINA.
Xian Lab. of Loess and Quaternary Geology (China).
X. Zhang, D. L. Higgitt, and D. E. Walling.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 3, p 243-252, June 1990. 2 fig, 2 tab, 17 ref.

Descriptors: *Cesium radioisotopes, *China, *Environmental tracers, *Erosion rates, *Soil erosion, *Tracers, Land use, Loess, Slope degradation, Soil profiles, Topography.

The radionuclide cesium-137 shows potential as an environmental tracer to indicate sources of soil erosion in the Chinese Loess Plateau. The cesium-137 contents of soil profiles were used to estimate soil erosion losses from different topographic and land use conditions at Lishi, Shanxi, Province, and Luochuan, Shaanxi Province. At uncultivated sites, the cesium-137 was found to accumulate in the upper soil profile, while it was evenly mixed within the plow layer of cultivated soils. Eroded soils contained relatively less cesium-137, and simple calibration techniques were applied to quantify soil loss. The results point to considerable spatial variation in erosion rates within the two study areas. Based on these preliminary results, it is suggested that cesium-137 may be of considerable value in assembling data on the rates and spatial distribution of soil loss and in identifying the source areas of eroded sediment. (Author's abstract)
W91-00405

BIAS AND VARIANCE OF SOME ESTIMATORS OF SUSPENDED SEDIMENT LOAD.
Instituto de Pesquisas Hidraulicas, Porto Alegre (Brazil).
R. T. Clark.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 3, p 253-261, June 1990. 1 tab, 9 ref.

Descriptors: *Estimating equations, *Sediment load, *Sediment yield, *Statistical analysis, *Suspended sediments, Correlation analysis, Probability distribution, Sampling, Sediment concentration, Sediment discharge, Standard deviation.

Expressions for the means and variance of three estimates of suspended sediment load are presented. These estimates assume that suspended sediment concentration, c, and mean daily discharge, q, are bivariate lognormally distributed. With this assumption, not inconsistent with the literature and with sedimentological data from the Rio Uruguai (Brazil/Argentina), one of the three estimates was unbiased and the other two were found to be biased, the bias being an exponential function of the correlation and standard deviations in the lognormal distribution. This confirms empirical findings and supports theoretical results which were established without distributional assumptions. Expressions for the variances of the three estimators of suspended sediment loads also confirmed the empirical results, the unbiased estimate having variance of order $1/n$ while the biased estimates had variances of order $1/n$ squared. These results are limited in that they are concerned only with what have been termed interpolation procedures, and not with the more widely used procedures that employ rating curves to express the relation between sediment concentration and discharge. It has also been assumed throughout that the concentration measurements can be regarded as randomly sampled from the time series of concentration values, and the results that are given apply only where this assumption is valid. In particular, the results will not apply if concentration is sampled more frequently at higher discharge, or if the inaccessibility of sampling sites during periods of heavy flooding causes samples to be missed. (Fleishman-PTT)
W91-00406

COUPLED SIMULATION OF TRANSIENT BED EVOLUTION IN ALLUVIAL CHANNELS.
National Chiao Tung Univ., Hsinchu (Taiwan). Dept. of Civil Engineering.
J. C. Yang, and J. Y. Wang.
Hydrological Sciences Journal HSJODN, Vol. 35, No. 3, p 263-284, June 1990. 10 fig, 2 tab, 19 ref, 2 append.

Descriptors: *Alluvial channels, *Channel morphology, *Flow models, *River beds, *Sediment transport, *Simulation analysis, Flood peak, Flow discharge, Momentum equation, Performance evaluation, Taiwan.

In dealing with the transient sediment transport problem, the commonly used uncoupled model may not be suitable. The uncoupling technique is intended to separate the physical coupling phenomenon of water flow and sediment transport into two independent processes. Very often, as a result, severe numerical oscillation and solution instability problems appear in the simulation of transient sediment transport in alluvial channels. The coupled model, which simultaneously solves water flow continuity, momentum and sediment continuity equations, gives fewer numerical oscillation and solution instability problems. A coupled model using a matrix double-sweep method to solve the system of nonlinear algebraic equations has been developed. Several test runs designed on the basis of a schematic model have been performed. The numerical oscillation and solution instability problems have been investigated through a comparison with those obtained from an uncoupled model. Based on the proposed case studies, it can be concluded that, for transient bed evolution, the performance of the coupled model is much better than that of the uncoupled model. The numerical oscillation is reduced and the solution more stable. This newly developed coupled model was also applied to the Cho-Shui River in Taiwan. This application study implied that the effect of the peaky flood wave propagation on the bed evolution could be simulated better by the coupled model than by the uncoupled model. (Author's abstract)
W91-00407

MINERALIZATION, PORE WATER CHEMISTRY AND PHOSPHORUS RELEASE FROM PEATY SEDIMENTS IN THE EUTROPHIC LOOSDRECHT LAKES, THE NETHERLANDS.
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 2H.
W91-00426

HYDROLOGIC AND CHEMICAL-QUALITY DATA FROM FOUR RURAL BASINS IN GUILFORD COUNTY, NORTH CAROLINA, 1985-88.

Geological Survey, Raleigh, NC.
For primary bibliographic entry see Field 5B.
W91-00433

CHANNEL CHANGES AT CROSS SECTIONS OF THE POWDER RIVER BETWEEN MOORHEAD AND BROADUS, MONTANA, 1975-88.
Geological Survey, Denver, CO.
J. A. Moody, and R. H. Meade.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 89-407, 1990. 252p, 94 fig, 29 tab, 4 ref.

Descriptors: *Channel erosion, *Channel morphology, *Channel stability, *Dam effects, *Montana, *Powder River, Cross-sections, Deposition, Floods, River beds.

Bed elevations were measured at 23 cross sections along a 95-kilometer reach of the Powder River between Moorhead and Broadus, Montana. The measurements were repeated each year (except 1976, 1981, and 1983) after the peak runoff and include measurements made before and after the flood of May 1978. As a result of the flood, the average of the changes in the minimum riverbed elevations at 17 cross sections indicated a decrease in elevation of 0.15 m, but this change was followed by a 0.17-m increase in the minimum riverbed elevation during the years after the flood (1978-88). There was essentially no net change in the minimum riverbed elevation for the study reach during 1977-88. The areas of erosion and deposition calculated for successive years at each cross section as a measure of channel change indicated that, during the 1978 flood, the average net channel change (deposition minus erosion) for the study reach was the erosion of 16 cu m of sediment/m of channel length. After the 1978 flood, the channel changes were characterized by multiple areas of erosion, which became areas of deposition during the following year and areas of deposition which became areas of erosion. The average net channel change for the entire study reach during the years since the 1978 flood was the average deposition of about 1 cu m of sediment/m of channel length. Thus, during 1977-88 there was a net erosion of about 15 cu m of sediment/m of channel length within the study reach. (Author's abstract)
W91-00436

CHANNEL AND BANK STABILITY OF OSBORNE CREEK AT U.S. HIGHWAY 45 NEAR WHEELER, PRENTISS COUNTY, MISSISSIPPI.
Geological Survey, Jackson, MS.
K. Van Wilson, and D. P. Turnipseed.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 89-581, 1989. 13p, 4 fig, 3 tab, 20 ref. Prepared in cooperation with the Mississippi State Highway Department.

Descriptors: *Bank erosion, *Channel stability, *Highway relocation, *Mississippi, *Osborne Creek, Bankfull stage, Channel scour, Floods, Soil properties, Streambeds.

The channel of Osborne Creek at existing U.S. Highway 45 near Wheeler, Mississippi, has degraded about 8 ft and widened about 33 ft since 1936. Channel degradation has totaled about 6 ft in the channel reach in the vicinity of the proposed U.S. Highway 45 relocation. Botanical evidence indicates that several bank failures downstream of the proposed relocation occurred during floods in 1983 and 1987-88. Rates of channel gradation and widening--as determined from channel descriptions and botanical evidence along the banks--were used in conjunction with soil properties to estimate probable future channel degradation and widening at the proposed relocation through the year 2010. By assuming that channel-bed elevations can be expressed as a power function with time, additional channel degradation through the year 2010 could approach 1 to 2 ft at the existing and proposed crossing of Osborne Creek. By comparison of projections of slough lines and temporary angles of stability with bankfull channel widths as a power function with time, about 10 ft of additional widening could reasonably be expected through the year 2010. These projections are based on the assumption that no additional channel modifications and no unusually large and destructive flooding will occur by the year 2010. (Author's abstract)
W91-00437

CHANNEL AND BANK STABILITY OF TWENTYMILE CREEK AT U.S. HIGHWAY 45 NEAR WHEELER, PRENTISS COUNTY, MISSISSIPPI.
Geological Survey, Jackson, MS.
D. P. Turnipseed, and K. Van Wilson.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 90-111, 1990. 16p, 4 fig, 4 tab, 21 ref. Prepared in cooperation with the Mississippi State Highway Department.

Descriptors: *Bank erosion, *Channel stability, *Highway relocation, *Mississippi, *Twentymile Creek, Channel scour, Channeling, Floods, Riparian vegetation, Soil properties.

The channel of Twentymile Creek at existing U.S. Highway 45 near Wheeler, Mississippi, has degraded about 8 ft and widened about 73 ft since it was channelized in about 1912. No recent (at least since 1968) channel degradation or widening is evident on Twentymile Creek near the proposed U.S. Highway 45 relocation. Botanical evidence indicates that both banks in the vicinity of the proposed relocation are fairly stable, but the removal of mature riparian vegetation from channel banks could result in near-future instability. Rates of channel gradation and widening--as determined from channel descriptions, discussions with local residents, and botanical evidence along the banks--were used in conjunction with soil properties to estimate probable future channel degradation and widening through the year 2010. No additional channel degradation through the year 2010 is expected at the existing and proposed crossing of Twentymile Creek. At existing U.S. Highway 45, the channel width could increase about 15 ft through the year 2010; at the proposed relocation, the channel width could increase about 20 ft in the next 10 to 20 years if mature riparian vegetation is removed from the channel banks. These projections are based on the assumption that no additional channel modifications and no unusually large and destructive flooding will occur by the year 2010. (Author's abstract)
W91-00439

INTERACTIONS OF CONTAMINANTS WITH SEDIMENT AND WATER IN RESERVOIRS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W91-00560

SPATIAL VARIATIONS IN THE RATE OF FLUVIAL EROSION (SEDIMENT PRODUCTION) OVER SOUTH AFRICA.
Orange Free State Univ., Bloemfontein (South Africa).
J. S. Le Roux.
Water SA WASADV, Vol. 16, No. 3, p 185-194, July 1990. 8 fig, 1 tab, 50 ref.

Descriptors: *Denudation, *Erosion, *Erosion rates, *Reservoir sediments, *South Africa, *Stream erosion, Data interpretation, Fluvial sediments, Precipitation, Rainfall-runoff relationships, Regional analysis, Spatial variation, Watersheds.

This study was based on the rate of sedimentation of 87 major storage dams in South Africa with sedimentation records exceeding 15 years. The catchments cover a 23% sample of the total land area of South Africa and represent the main climatic zones. The rate of denudation of the past 10 to 50 years was calculated from sediment accumulated in the man-made reservoirs. The rate of surface lowering generally increases from west to east over the subcontinent. This increase more or less coincides with both an increase in annual precipitation and an increase in the number of storms of high intensity. On the whole there is an increase in relief from west to east, but relief seems to be only a secondary factor in the explanation of denudation rate. The rate of erosion is probably at least twice to three times or more the rate of replacement by weathering. It is concluded that the rate of denudation is mostly a function of rainfall parameters and several passive factors and it is unlikely that a single parameter can be devised which would be able to explain the regional denudation pattern. No conclusive evidence could be found from reservoir sedimentation rates that denudation rates have either decreased or increased over the last 10 to 50 years. (Author's abstract)
W91-00635

EFFECT OF TIDAL ACTION ON THE TRANSFORMATIONS OF NITROGEN IN FRESHWATER TIDAL FLAT SEDIMENTS.
Hamburg Univ. (Germany, F.R.). Fachbereich 14 - Biologie.
For primary bibliographic entry see Field 5B.
W91-00649

SEASONAL VARIATION IN THE STRUCTURE OF THE MICROBIAL COMMUNITY CAPABLE OF NITRATE RESPIRATION IN AN INTERTIDAL MUD FLAT SEDIMENT FROM THE ELBE ESTUARY.
Hamburg Univ. (Germany, F.R.). Fachbereich 14 - Biologie.
For primary bibliographic entry see Field 2L.
W91-00650

RETENTION AND RESUSPENSION OF PHOSPHORUS, NITROGEN, AND IRON IN A CENTRAL ONTARIO LAKE.
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
For primary bibliographic entry see Field 2H.
W91-00656

PIGMENT STRATIGRAPHY AND TROPHIC STATUS: AN EVALUATION OF RADIONUCLIDE-DATED LACUSTRINE SEDIMENT.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
For primary bibliographic entry see Field 2H.
W91-00692

POREWATER MIXING BY MICROORGANISMS, MONITORED BY A RADIOTRACER METHOD.
Stockholm Univ. (Sweden). Dept. of Geology.
P. Ostlund, R. O. Hallberg, and L. Hallstadius.
Geomicrobiology Journal GEJODG, Vol. 7, No. 4, p 253-264, 1989. 6 fig, 1 tab, 10 ref.

Descriptors: *Bioturbation, *Interstitial water, *Microorganisms, *Radioactive tracers, *Sediment chemistry, Diffusion coefficient, Xenon radioisotopes.

Bioturbation is an important process for the transport and mixing of solutes and particles in sediments. Mixing of porewater caused by motile microorganisms has not previously been considered to be of significance in this context. A radiotracer method using Xe-133 has been developed for the direct comparison of mixing of a soluble inert substance in microbially active and sterile sediments. Results showed clear evidence of porewater mixing caused by motile microorganisms. Estimated diffusion coefficients (expressed as mixing coefficients) were found to be 20% larger in microbially active sediments than in sterile ones. (Author's abstract)
W91-00693

TWO HYDRODYNAMICALLY STABLE SELF-SUSPENDED BUOYANT SEDIMENT TRAPS.
Stockholm Univ. (Sweden). Dept. of Zoology.
D. Broman, J. Kugelberg, and C. Naf.
Estuarine, Coastal and Shelf Science ECSSD3, .

Vol. 30, No. 4, p 429-436, April 1990. 2 fig, 19 ref.

Descriptors: *Samplers, *Sampling, *Sediment sampler, *Sedimentation, Design criteria, Limnology, Oceanography.

Two self-buoyant sediment traps using straight cylindrical sediment collection vessels have been designed and tested. The constructions are hydrodynamically stable and the vertical alignment of the sediment collection vessels are retained both in laminar and moderately turbulent water currents with flow rates up to 40 cm/sec for the nondisplacing, and at least 45 cm/sec for the displacing, sediment trap type. Both constructions are simple and easily handled. (Author's abstract)
W91-00721

SEDIMENT-WATER INTERACTION AS A CONTROL ON GEOCHEMICAL EVOLUTION OF PLAYA LAKE SYSTEMS IN THE AUSTRALIAN ARID INTERIOR.
Queensland Univ. of Technology, Brisbane (Australia). Dept. of Applied Geology.
For primary bibliographic entry see Field 2H.
W91-00736

METAL CONCENTRATIONS IN SURFICIAL SEDIMENTS FROM HYPERSALINE LAKES, AUSTRALIA.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
For primary bibliographic entry see Field 2K.
W91-00737

INFLUENCE OF SALINITY ON THE CONCENTRATION AND RATE OF INTERCHANGE OF DISSOLVED PHOSPHATE BETWEEN WATER AND SEDIMENT IN FUENTE PIEDRA LAGOON (S. SPAIN).
Malaga Univ. (Spain). Facultad de Ciencias.
For primary bibliographic entry see Field 2L.
W91-00743

ABSOLUTE DATING OF SEDIMENTATION ON LAKE TORRES WITH SPRING DEPOSITS, SOUTH AUSTRALIA.
Zambia Univ., Lusaka. School of Mines.
For primary bibliographic entry see Field 2H.
W91-00760

SEDIMENT YIELD AND DISCHARGE IN MOUNTAINOUS SMALL RIVER BASINS: ACTUAL CONDITION OF SEDIMENT DISCHARGE AFTER DAMAGE CAUSED BY SAND AND STONE AVALANCHES (IN JAPANESE).
K. Tsunamoto, M. Kimura, and S. Mutou.
Research Bulletin of the Faculty of Agriculture Gifu University, No. 54, p 29-38, December 1989. 7 fig, 5 tab, 3 ref. English summary.

Descriptors: *Avalanches, *Landslides, *Mountain streams, *Sediment yield, *Sedimentation, *Storm runoff, *Watershed management, Check dams, Dams, Disasters, Environmental effects, Forest watersheds, Rivers, Runoff, Sediment discharge, Streams.

To obtain fundamental data for disaster prevention in mountainous small river basins, actual conditions of sediment yield and discharge were investigated in 19 rivers after a disaster. It was found that the landslide occurrence ratio was low and on a scale that was small considering that it was in a rainy district. Most debris passed through the forest into the channel causing an increase in sediment deposition. Most check dams constructed after disaster were not filled up with sediment, and no large sediment discharge caused by rain has occurred since. When the stream length was large, the slope of the stream bed was small, and sediment deposition increased. In view if these results, it was inferred that sediment deposition was affected by the river itself when the river basin was small and there was no change in environmental conditions. Since these rivers tend to have extensive sediment deposition in valley outlets when it rains heavily, appropriate forest treatment must be carried out. (Agostine-PTT)
W91-00766

DISTRIBUTION AND TRANSPORT OF SEDIMENT-BOUND METAL CONTAMINANTS IN THE RIO GRANDE DE TARCOLES, COSTA RICA (CENTRAL AMERICA).
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W91-00804

EFFECT OF WATER DEPTH AND CLIPPING FREQUENCY ON THE GROWTH AND SURVIVAL OF FOUR WETLAND PLANT SPECIES.
Iowa State Univ., Ames. Dept. of Botany.
B. A. Middleton.
Aquatic Botany AQBODS, Vol. 37, No. 2, p 189-196, July 1990. 1 fig, 15 ref. Smithsonian Grant 43600.

Descriptors: *Aquatic plants, *Geese, *Herbivores, *Limnology, *Plant growth, *Wetlands, Clipping frequency, Experimental data, Field tests, India, Keoladeo National Park, Monsoonal wetlands, Rooted aquatic plants, Water depth.

Geese and other herbivores seem to be responsible for the creation of openings in many wetlands. The hypothesis that underwater clipping can kill wetland plants was tested in an experimental study conducted in north-central India. Four plant species were either clipped weekly, clipped every 2 weeks, or left unclipped while growing at one of three water levels (0, 3 or 13 cm above the soil surface). When clipped underwater, individuals of three emergent species, Ipomoea aquatica, Paspalidium punctatum and Paspalum distichum, usually died, but those of Nymphoides cristatum Kuntze did not. Clipped plants of N. cristatum had as much total biomass as unclipped plants, with increased mean shoot biomass but reduced mean root biomass in 3 cm of water. The three emergent species lived when clipped every 2 weeks in 0 cm of water. Clipped plants of emergents had less total mass and less root mass than unclipped plants in 0 cm of water. In a field study in a monsoonal wetland in the Keoladeo National Park, plants of Ipomoea aquatica and Paspalum distichum died when clipped underwater. (Author's abstract)
W91-00836

TOPOGRAPHIC EFFECTS ON FLOW PATH AND SURFACE WATER CHEMISTRY OF THE LLYN BRIANNE CATCHMENTS IN WALES.
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 2E.
W91-00888

INFLUENCE OF THE ANGLE OF INCIDENCE OF THE RAINFALL ON THE OVERLAND FLOW PROCESS.
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
J. L. M. le Lima.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 73-82. 7 fig, 12 ref.

Descriptors: *Computer models, *Erosion, *Kinematic wave theory, *Model studies, *Overland flow, *Rainfall, *Rainfall impact, *Rainfall-runoff relationships, *Wind velocity, Computer programs, Mathematical models, Soil erosion.

The influence of the angle of incidence of rainfall in the overland flow process and soil erosion was examined. A method, based on the kinematic wave theory, was developed in which overland flow, under rainfall from any dominant direction, is simplified by taking a one-dimensional flow process by means of spatial rotation of the surface (assumed to be a plane). The acceleration of gravity is modified at every instant to take into account the effect of the impinging raindrops. A computer program was developed to numerically solve the kinematic wave equations for overland flow under inclined rainfall and also considering the effect of the wind shear stress and of the splash. Wind tunnel experiments in the laboratory were conducted to verify the model. Although the model is not the most sophisticated one possible, it may prove to be accurate enough for practical purposes in assessing factors that affect overland flow under inclined rainfall. Further improvement could be obtained by coupling the model with a sediment transport model. (See also W91-00961) (Sand-PTT)
W91-00969

REVIEW OF THE SEARCH FOR A QUANTITATIVE LINK BETWEEN HYDROLOGIC RESPONSE AND FLUVIAL GEOMORPHOLOGY.
Massachusetts Inst. of Tech., Cambridge.
For primary bibliographic entry see Field 2E.
W91-00977

GEOMORPHOCLIMATIC DERIVATION OF FLOOD FREQUENCY (PEAK AND VOLUME) AT THE BASIN AND REGIONAL SCALE.
Politecnico di Milano (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 2E.
W91-00978

2K. Chemical Processes

MEASUREMENTS OF GAS CONCENTRATION FLUCTUATIONS AT WATER SURFACE.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
G. H. Jirka, and A. H. W. Ho.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 835-847, June 1990. 11 fig, 9 ref. NSF Grant CEE-8004621.

Descriptors: *Air-water interfaces, *Laboratory methods, *Oxygen, *Water boundary, *Water chemistry, *Water properties, Solubility, Volatility.

The transfer of gases across the air-water interface is a critical element in the natural geochemical cycling of materials, as well as for the transport of pollutants in the environment. Experiments in a grid-stirred laboratory tank (0.5 m x 0.5 m x 0.4 m) have been conducted to investigate the details of the surface transfer mechanisms, including the structure of up or downwelling motions and existence of various boundary layers. In addition to earlier two-component measurements of the turbulent near-surface velocity field, a gas microprobe has been constructed and used for measurements of gas fluctuations. The gas probe uses the polarographic principle for the measurement of oxygen and has tip dimensions on the order of a few microns. Measurements are presented that display the conditions in the gas boundary layer (about 400-microns thickness), including mean and fluctuating conditions. The mean gas concentration profile indicates a monotonic decrease with depth within the surface gas boundary layer. Turbulent fluctuations appear to reach much deeper, well below the lowest near-surface measuring point (500 microns). (Author's abstract)
W91-00065

LONGITUDINAL AND SEASONAL WATER CHEMISTRY VARIATIONS IN A NORTHERN APPALACHIAN STREAM.
Marian Coll., Indianapolis, IN. Dept. of Biology.
R. A. Phillips, and K. M. Stewart.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 489-498, June 1990. 5 fig, 1 tab, 37 ref.

Descriptors: *Acid rain effects, *Acid streams, *Buffer capacity, *Chemical properties, *Soil types, *Water chemistry, Alkalinity, Conductivity, Hydrogen ion concentration, New York, Nitrates, Rainfall, Seasonal variation, Snowmelt, Temporal distribution.

Quaker Run, a fourth order stream located in southwestern New York State, exhibits a highly unusual chemical gradient along its upper reaches. Weekly water samples showed an increase in the mean annual pH from 5.07 to 7.01 along a stretch of only 2.2 km. Mean alkalinity, calcium, magnesium, sodium, potassium, nitrate-nitrite-nitrogen,

silica, and conductivity also increased appreciably over this distance. The study area receives some of the most highly acidic atmospheric deposition in the United States. Minimal buffering of these acidic inputs in the extreme upper watershed, and an abrupt downstream increase in buffering associated with changes in soil type, apparently produce the observed streamwater chemistry gradient. In contrast, a comparison between 11 midstream, downstream, and tributary sites showed relatively little variation in streamwater chemistry. In addition to the pronounced longitudinal chemistry changes along the upper portion of the stream, pronounced temporal chemistry variations were also observed at all sampling sites. High flow during snowmelt and heavy rains produced more dilute, acidic conditions, while streamwater pH and dissolved base cations were generally highest during low flow. Much of this temporal variation in streamwater chemistry is attributed to seasonal variation in residence times of soil water. (Author's abstract)
W91-00089

HYDROCHEMICAL CHARACTERIZATION OF GROUNDWATER MIXING IN SEDIMENTARY AND METAMORPHIC RESERVOIRS WITH COMBINED USE OF PIPER'S PRINCIPLE AND FACTOR ANALYSIS.
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
M. Razack, and J. Dazy.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 371-393, May 1990. 9 fig, 6 tab, 50 ref.

Descriptors: *Geochemistry, *Groundwater quality, *Groundwater recharge, *Metamorphic aquifers, *Sedimentary aquifers, *Water chemistry, Aquifer systems, Data interpretation, Factor analysis, France, Groundwater movement, Groundwater pollution, Mixing, Physicochemical properties.

The understanding of flow and water quality in groundwater systems, and the identification of recharge areas is a present need, especially as hydrogeologists are increasingly confronted with groundwater contamination problems. To compare and identify water masses, a large amount of water quality data may be needed. Hydrogeologists have turned to mathematical tools such as factor analysis for interpretation. A procedure to interpret hydrochemical data based on a combined use of factor analysis (correspondence analysis) and Piper's classification principle was applied to the study of a multireservoir hydrothermal system located in the French Western Alps. Values of physicochemical parameters determined on 95 water samples related to a single point and gathered from previous studies extending over several decades were submitted to this procedure. The approach proved successful in differentiating groundwater masses of different hydrogeological origin which mix and discharge at the outlet of the system. The statistical analysis, supported by structural and isotopic information, allowed formulation of a flow and mixing model in agreement with geological evidence and comprising near-surface, subsurface and deep subsystems. (Author's abstract)
W91-00164

GEOCHEMISTRY OF WATER ASSOCIATED WITH THE NAVAJO SANDSTONE AQUIFER, SAN RAFAEL SWELL AREA, UTAH.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00312

METHODS AND PRELIMINARY RESULTS OF GEOCHEMICAL SAMPLING, SAN JUAN BASIN, NEW MEXICO, COLORADO, ARIZONA, AND UTAH.
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00317

STREAMFLOW AND WATER-QUALITY DATA FOR LITTLE SCRUBGRASS CREEK BASIN, VENANGO AND BUTLER COUNTIES, PENNSYLVANIA, DECEMBER 1987 - NOVEMBER 1988.
Geological Survey, Harrisburg, PA.
For primary bibliographic entry see Field 2E.
W91-00357

SOLINPUT: A COMPUTER CODE TO CREATE AND MODIFY INPUT FILES FOR THE GEOCHEMICAL PROGRAM SOLMINEQ.88.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7C.
W91-00359

SUGGESTED METHODS FOR CALCULATING AND INTERPRETING CALCIUM CARBONATE SATURATION INDEXES.
D. T. Merrill, R. W. Lane, R. A. Pisigan, G. C. Richards, and J. R. Rossum.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 7, p 71-77, July 1990. 3 tab, 45 ref.

Descriptors: *Calcium carbonate, *Chemical analysis, *Saturation index, *Water analysis, *Water chemistry, *Water treatment, Alkalinity, Calcium, Chemical precipitation, Computers, Deposition, Hydrogen ion concentration, Mathematical equations, Water delivery, Water distribution.

Calcium carbonate ($CaCO_3$) saturation indexes are commonly used to evaluate the scale-forming and scale-dissolving tendencies of water. Assessing these tendencies is useful in corrosion control programs and in preventing $CaCO_3$ scaling in piping and equipment. Several water quality characteristics must be measured to calculate the $CaCO_3$ saturation indexes, with minimum requirements being total alkalinity, total calcium, ionic strength, pH and temperature. $CaCO_3$ saturation indexes are grouped into two categories: (1) Indexes that indicate $CaCO_3$ precipitation or dissolution tendencies define whether a water is oversaturated, saturated or undersaturated with respect to $CaCO_3$. These include the Saturation Index (SI); the Relative Saturation (RS; also known as the Driving Force Index); and the Ryzner Index (RI). The RS and SI are related. The RI has been used for many years, sometimes with good results, however, it is semiempirical and therefore may be less reliable than SI. A positive SI connotes a water oversaturation with respect to $CaCO_3$; a negative SI signifies an undersaturated water; an SI of zero represents a water in equilibrium with $CaCO_3$. (2) An index that the quantity of $CaCO_3$ that may be precipitated or dissolved is the Calcium Carbonate Precipitation Potential (CCPP). The CCPP is defined as the quantity of $CaCO_3$ that theoretically can be precipitated from oversaturated waters or dissolved by undersaturated waters during equilibration. The CCPP is negative for undersaturated waters and positive for oversaturated waters. None of the calculations of $CaCO_3$ saturation indexes adequately describe exception conditions, such as the inhibition of $CaCO_3$ deposition by the presence of phosphates. Similarly, the effects predicted by the indexes do not always conform to expectations. Thus, estimates of corrosion rates should not be based on $CaCO_3$ indexes alone. There is a source listing and description of diagrams and computer software for $CaCO_3$ indexes. (Hoskin-PTT)
W91-00380

DETERMINATION OF GOLD AT FEMTOMOLAR LEVELS IN NATURAL WATERS BY FLOW INJECTION INDUCTIVELY COUPLED PLASMA QUADRUPOLE MASS SPECTROMETRY.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
K. K. Falkner, and J. M. Edmond.
Analytical Chemistry ANCHAM, Vol. 62, No. 14, p 1477-1481, July 15, 1990. 2 fig, 4 tab, 28 ref.

Descriptors: *Analytical methods, *Chemical analysis, *Gold, *Mass spectrometry, *Pollutant identification, *Seawater, *Water analysis, Anion exchange, Atlantic Ocean, Detection limits, Laboratory methods, Mediterranean Sea, Pacific Ocean, Precision, Radioactive tracers.

A method for the determination of Au in seawater at femtomolar (fm) levels (10 fm/L) levels involves preconcentration by anion exchange of Au as a cyanide complex using Au-195 radiotracer (half-life= 183 days) to monitor recoveries. Samples are then introduced by flow injection into an inductively coupled plasma quadrupole mass spectrometer for analysis. The method has a detection limit of approximately 10 fM for 4 L of seawater preconcentrated to 1 ml and a relative precision of 15% at the 100 fM level. Au levels of 10-100 fM were confirmed in seawater at Atlantic and Pacific Ocean and Mediterranean Sea locations. With slight modifications, the technique can also be applied to the analysis of hydrothermal fluids and freshwaters. (Author's abstract)
W91-00388

ESTIMATES OF ION SOURCES IN DECIDUOUS AND CONIFEROUS THROUGHFALL.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-00415

GEOCHEMISTRY OF IRON IN A SAND DUNE AQUIFER, NEAR COOS BAY AND NORTH BEND, OREGON.
Geological Survey, Portland, OR.
G. C. Bortleson, M. A. Jones, and P. P. Hearn.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. US Geological Survey Open-File Report 88-734, 1989. 37p, 1 plate, 14 fig, 13 tab, 26 ref. Prepared in cooperation with the Coos Bay-North Bend Water Board.

Descriptors: *Geochemistry, *Iron, *Oregon, *Sand aquifers, *Water chemistry, Carbon dioxide, Carbonates, Coniferous forests, Coos Bay, Dunes, Organic compounds.

Geochemical processes that control dissolved iron concentrations were studied in a sand dune aquifer used for municipal and industrial water supply near Coos Bay and North Bend, Oregon. Elevated concentrations of dissolved organic compounds and carbon dioxide produced from the root zone and litter of lodgepole pine forest (Pinus contorta) increase the capacity of shallow groundwater to dissolve iron-bearing minerals. Dissolved iron concentrations are largest (7,300 to 27,000 mg/L) in shallow groundwater that has infiltrated areas of dense lodgepole pine forest and smallest (15 to 3,900 mg/L) in water that has infiltered bare sand. Water beneath both forested and bare sand areas is devoid of oxygen and pH is similar in all areas (pH 5.6 to 6.7). The pH of shallow groundwater that had infiltered forested areas tends to be higher than in bare sand areas, but differences are slight. In contrast to shallow water beneath forested areas, water from the deeper parts of the aquifer in the southern part of the dunes has concentrations of dissolved iron that range from a few tens to a few hundreds of mg/L. Large carbonate-bicarbonate concentrations from the dissolution of marine shell fragments causes precipitation of siderite ($FeCO_3$) and removal of little or no shell material, and iron concentrations are not limited by carbonate equilibria. Therefore, dissolved iron concentrations in these areas generally increase with depth, but these concentrations may not be solely a function of depth or residence time. (Author's abstract)
W91-00430

STREAMFLOW AND WATER-QUALITY DATA FOR MEADOW RUN BASIN, FAYETTE COUNTY, PENNSYLVANIA, DECEMBER 1987 - NOVEMBER 1988.
Geological Survey, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W91-00431

DESTRUCTION OF HAZARDOUS CHEMICAL WASTE BY OXIDATION IN SUPERCRITICAL WATER.
Los Alamos National Lab., NM.
For primary bibliographic entry see Field 5D.

W91-00450

CHEMISTRY OF BROMINE TRANSFER: DISPROPORTIONATION AND HYDROLYSIS IN BROMAMINE SYSTEMS.
Hartford Univ., West Hartford, CT. Dept. of Chemistry.
E. T. Gray, and H. J. Workman.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 833-847, 5 fig, 5 tab, 15 ref, 2 append.

Descriptors: *Bromination, *Bromine, *Chemical analysis, *Chemical reactions, *Hydrolysis, *Water analysis, *Water chemistry, Organic compounds, Water treatment.

A systematic determination of the equilibrium constants, rate constants and reaction mechanisms associated with the bromination of amine moieties, with an emphasis on organic amines is presented. Concentration is placed on the transfer of active bromine using the bromamines of dimethylamine and beta-aniline, since these exemplars of organic bromamines can be stable to reductive loss for at least a period of a few minutes. The equilibrium constant for the hydrolysis of dimethylbromamine and the equilibrium constant for the disproportionation of N-bromo-beta-alanine have been obtained. Also N,N-dibromo-beta-alanine has been shown to hydrolyze in mildly acidic conditions. In general, the concentration of uncombined halogen is much greater for bromamine solutions than for comparable chloramine solutions. Furthermore, it appears that almost all the important constants describing bromamine chemistry in aqueous solutions can be measured directly, with the notable exception of the protonation constant of the monobromamine species. The continued goal of this research is to make the determination of these constants routine, so that critical equilibrium and rate constants for bromamine systems may be rapidly determined across a wide range of amine species. (See also W91-00476) (Lantz-PTT)
W91-00540

COKRIGING TO ASSESS REGIONAL STREAM QUALITY IN THE SOUTHERN BLUE RIDGE PROVINCE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W91-00589

COMPARATIVE ANALYSIS OF ALUMINUM BIOGEOCHEMISTRY IN A NORTHEASTERN AND A SOUTHEASTERN FORESTED WATERSHED.
Maine Univ., Orono. Dept. of Botany.
C. S. Cronan, C. T. Driscoll, R. M. Newton, J. M. Kelley, and C. L. Schofield.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1413-1430, July 1990. 10 fig, 8 tab, 85 ref. EPRI Contract RP2356.

Descriptors: *Acid rain effects, *Aluminum, *Chemical analysis, *Forest watersheds, *Path of pollutants, *Water chemistry, Acidity, Adirondack Mountains, Alkalinity, Aluminum cycling, Anions, Cations, Comparison studies, Cumberland Plateau, Forest ecosystems, Ion transport, New York, Nitrates, Organic carbon, Sulfates, Tennessee.

A comparative biogeochemical analysis focused on aluminum cycling in two small watersheds, one in the west-central Adirondacks of New York and the other on Cumberland Plateau of eastern Tennessee. Despite similarities in soil acidity, soil exchangeable Al concentrations, and elevated inputs of acidic deposition, the northern and southern sites exhibited strong differences in aqueous Al chemistry and transport. Soil and stream drainage waters in the northern watershed were more acidic, and contained higher concentrations of base cations, sulfate, nitrate, and organic carbon than waters in the southern ecosystem. Mean concentrations of biologically active inorganic Al ranged from 17 to 46 micromol/L in soil solutions and stream water in the northern drainage basin, and from 0 to 2 micromol/L in the southern system. The major differences in Al chemistry and transport between the two watersheds were related to different patterns of alkalinity and anion transport in these contrasting systems. In the northern watershed, atmospheric inputs of acidity were partially neutralized through the release of cations (Ca, Al, Mg, K, and Na) from soils and detritus. Because of the high mobility of sulfate and nitrate in the northern watershed, there was significant transport of Al through the soil and into stream water. At the southern watershed, soil sulfate adsorption, biological retention of nitrate, and base cation release were the major sources of acid neutralizing capacity for soil drainage waters and surface waters. Because these processes resulted in both the release of alkalinity and the removal of mobile strong acid anions, concentrations of labile Al remained low throughout most of the drainage profile in the southern watershed. At the ecosystem level, results indicated that Al cycling at the southern site was controlled more by biotic transfers (e.g., plant uptake and litterfall), while solution transfers (e.g., soil leaching) dominated Al cycling at the northern site. (Author's abstract)
W91-00590

GAS EXCHANGE RATES FOR A FIRST-ORDER STREAM DETERMINED WITH DELIBERATE AND NATURAL TRACERS.
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2A.
W91-00606

IDENTIFICATION OF SOLUBILITY-CONTROLLING SOLID PHASES IN A LARGE FLY ASH FIELD LYSIMETER.
Battelle Memorial Inst., Richland, WA. Pacific Northwest Labs.
For primary bibliographic entry see Field 5B.
W91-00621

SYNCHRONOUS FLUORESCENCE SPECTROSCOPY OF DISSOLVED ORGANIC MATTER IN SURFACE WATERS: APPLICATION TO AIRBORNE REMOTE SENSING.
Cornell Univ., Ithaca, NY. Cornell Lab. for Environmental Applications of Remote Sensing.
For primary bibliographic entry see Field 5A.
W91-00639

POTENTIAL BIO-AVAILABLE PHOSPHORUS IN SEDIMENTS OF THE RIVER ELBE IN NORTHERN GERMANY.
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Chemie.
For primary bibliographic entry see Field 2L.
W91-00651

EFFECT OF FLUORIDE COMPLEXATION ON ALUMINUM TOXICITY TOWARDS JUVENILE ATLANTIC SALMON (SALMO SALAR).
INRS-Eau, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5C.
W91-00663

PHYSICAL CHEMICAL PROPERTIES OF UNCHARGED WATER CLUSTERS AND ONE-DIMENSIONAL ICE BASED ON QUANTAL CALCULATIONS.
Missouri Univ.-Rolla. Dept. of Physics.
For primary bibliographic entry see Field 2C.
W91-00667

OXIDATION OF S(IV) IN RAIN-WATER COLLECTED IN JAPAN.
Institute of Public Health, Tokyo (Japan).
For primary bibliographic entry see Field 5B.
W91-00668

WET DEPOSITION OF VOLCANIC GASES AND ASH IN THE VICINITY OF MOUNT SAKURAJIMA.
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
For primary bibliographic entry see Field 5B.
W91-00669

ORIGIN OF SOLUBLE CHEMICAL SPECIES IN BULK PRECIPITATION COLLECTED IN TOKYO, JAPAN; STATISTICAL EVALUATION OF SOURCE MATERIALS.
Tokyo Inst. of Tech. (Japan). Dept. of Environmental Chemistry and Engineering.
For primary bibliographic entry see Field 5B.
W91-00670

MESOSCALE MODELING OF ACIDITY PRODUCTION IN OROGRAPHIC CLOUDS AND RAIN.
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. Associe de Meteorologie Physique.
For primary bibliographic entry see Field 5B.
W91-00671

HEAVY METALS DISTRIBUTION AND ENRICHMENT IN THE SEDIMENTS OF SOUTHERN EAST COAST OF INDIA.
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W91-00701

NEGATIVE OXYGEN TRENDS IN SWEDISH COASTAL BOTTOM WATERS.
Kristenebergs Marinbiologiska Station, Fiskebackskil (Sweden).
R. Rosenberg.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 335-339, July 1990. 3 fig, 1 tab, 29 ref.

Descriptors: *Dissolved oxygen, *Fjords, *Sweden, *Water depth, Brackish water, Eutrophication, Halocline.

Temporal trends in annual minimum oxygen concentrations in the bottom water of fourteen marine coastal areas, from the open coast to semi-enclosed areas, have been investigated from the early 1950's or 1960's up to 1984. The water at all locations is stratified more or less all year round, with brackish water at the surface, a halocline at 10 to 20 m, and deeper oceanic water below. The variation in bottom oxygen concentrations was great, with low minimum values (< 1 ml/L) recorded at the most enclosed stations. At twelve stations a significant declining trend could be demonstrated, but at three of these that trend could have been caused by slightly increased recordings over time. The likely reason for the decline is suggested to be increased large scale eutrophication, and such deterioration in the coastal marine environment could be interpreted as a serious warning signal. (Brunone-PTT)
W91-00703

COMPARATIVE DATA ON PRIMARY PRODUCTIVITY AND MINERAL PHOSPHORUS UPTAKE IN THE EUPHOTIC ZONE OF THE MEDITERRANEAN AND BLACK SEA.
Institutul Roman de Cercetari Marine, Constanta (Romania).
For primary bibliographic entry see Field 2L.
W91-00710

TRANSFORMATION AND TRANSPORT OF AMMONIUM NITROGEN IN A FLOODED ORGANIC SOIL.
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
For primary bibliographic entry see Field 5B.
W91-00716

NITROGENOUS NUTRIENT TRANSFORMATIONS IN THE SPRING AND FALL IN THE CHESAPEAKE BAY.

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 2L.
W91-00718

DETERMINATION OF WARFARIN IN DRINKING WATER BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY AFTER SOLID-PHASE EXTRACTION.
Gacell Labs. A.B., Malmo (Sweden). Analytical and Quality Development Dept.
For primary bibliographic entry see Field 5A.
W91-00723

DETERMINATION OF FUNGISTATIC QUATERNARY AMMONIUM COMPOUNDS IN BEVERAGES AND WATER SAMPLES BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY.
Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Elintarvikelaboratorio.
For primary bibliographic entry see Field 5A.
W91-00724

DETERMINATION OF BORATE AT TRACE LEVELS IN ENVIRONMENTAL SAMPLES BY ION-EXCLUSION CHROMATOGRAPHY.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5A.
W91-00725

DETERMINATION OF RESIN AND FATTY ACIDS IN PULP AND PAPER MILL EFFLUENTS AND WHITE WATERS BY GAS-LIQUID CHROMATOGRAPHY.
Ukrainskii Nauchno-Issledovatel'skii Inst. Tsellyuloznoii Bumazhno Promyshlennosti, Kiev (USSR).
For primary bibliographic entry see Field 5A.
W91-00726

SIMPLE DEVICE FOR THE DETERMINATION OF VOLATILE CHLORINATED HYDROCARBONS IN WATER BY GAS CHROMATOGRAPHY.
Vyzkumny Ustav Vodohospodarsky, Prague (Czechoslovakia).
For primary bibliographic entry see Field 5A.
W91-00727

SIMULTANEOUS DETERMINATION OF NITRITES, NITRATES AND AMINES BY ION-INTERACTION REVERSED-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY.
Turin Univ. (Italy). Dipt. di Chimica Analitica.
For primary bibliographic entry see Field 5A.
W91-00728

SEDIMENT-WATER INTERACTION AS A CONTROL ON GEOCHEMICAL EVOLUTION OF PLAYA LAKE SYSTEMS IN THE AUSTRALIAN ARID INTERIOR.
Queensland Univ. of Technology, Brisbane (Australia). Dept. of Applied Geology.
For primary bibliographic entry see Field 2H.
W91-00736

METAL CONCENTRATIONS IN SURFICIAL SEDIMENTS FROM HYPERSALINE LAKES, AUSTRALIA.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
W. B. Lyons, A. R. Chivas, R. M. Lent, S. Welch, and E. Kiss.
Hydrobiologia HYDRB8, Vol. 197, p 13-22, May 31, 1990. 3 fig, 5 tab, 23 ref.

Descriptors: *Australia, *Geochemistry, *Heavy metals, *Lakes, *Limnology, *Metals, *Saline lakes, *Sediments, *Water chemistry, Cyanophyta, Gold mining, Groundwater, Mine drainage, Minerals, Radioisotopes, Sinks, Sulfides.

A preliminary survey of analyzed surface sediment samples from approximately twenty lakes in Australia for Fe, Cu, Pb and Zn concentrations was conducted. In addition lake sediments from the gold mining areas of Western Australia (WA) were analyzed for Ag, and samples from NW Victoria were analyzed for Mn, Ni, Co, Cr and V. These lakes are discharge zones for regional and/or local saline groundwaters. The groundwaters entering many of these lakes have very low pH's (pH 3-4) and contain extremely high dissolved Fe concentrations. These low pH waters may also contain high concentrations of trace metals and radionuclides from the U-238 decay series. The WA data yield the following information: (1) with the possible exception of Ag, these sediments show no trace metal enrichments above average shale/sandstone values; (2) some lakes draining Archean gold mining terrain have high Ag concentrations; (3) the highest Pb concentrations are in a lake where acid groundwater input occurs; and (4) the acid mineral alunite does not appear to be a metal 'sink' in the acid groundwater lakes. In the two NW Victorian lakes, the sulfide zone below the cyanobacterial mat is enriched about 100 times for Cu, 30 times for Zn and 78 times for Pb compared to the sediments outside the discharge zone. The Victorian data set indicates a correlation between Cu and Zn and also between Cr and Ni concentrations. Three generations of 'ironstone-like' sediments were also analyzed. These iron-oxide rich sediments gained Cu but lost Co with age and maturation. The Mn concentration appears to be important in controlling the Zn and Cu in these 'ironstones'. It appears from the data that neither the oxide-rich nor the acid-rich authigenic sediment phases are major sinks for groundwater metal in these systems. (Author's abstract)
W91-00737

HEAVY METALS IN THE DEAD SEA AND THEIR COPRECIPITATION WITH HALITE.
Weizmann Inst. of Science, Rehovoth (Israel).
For primary bibliographic entry see Field 2H.
W91-00738

EVOLUTION OF SALINE LAKE WATERS: GRADUAL AND RAPID BIOGEOCHEMICAL PATHWAYS IN THE BASOTU LAKE DISTRICT, TANZANIA.
Michigan Univ., Ann Arbor. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-00739

HYDROGEOCHEMISTRY OF LAKE GALLOCANTA (ARAGON, NE SPAIN).
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W91-00740

RECENT CARBONATE SEDIMENTATION AND BRINE EVOLUTION IN THE SALINE LAKE BASINS OF THE CARIBOO PLATEAU, BRITISH COLUMBIA, CANADA.
Saskatchewan Univ., Saskatoon. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2H.
W91-00741

NUTRIENTS IN PORE WATERS FROM DEAD SEA SEDIMENTS.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2H.
W91-00742

INFLUENCE OF SALINITY ON THE CONCENTRATION AND RATE OF INTERCHANGE OF DISSOLVED PHOSPHATE BETWEEN WATER AND SEDIMENT IN FUENTE PIEDRA LAGOON (S. SPAIN).
Malaga Univ. (Spain). Facultad de Ciencias.
For primary bibliographic entry see Field 2L.
W91-00743

SOLUBILITY OF OXYGEN IN THE DEAD SEA BRINE.
Kinneret Limnological Lab., Tiberias (Israel).
A. Nishri, and S. Ben-Yaakov.
Hydrobiologia HYDRB8, Vol. 197, p 99-104, May 31, 1990. 6 fig, 2 tab, 12 ref.

Descriptors: *Analytical methods, *Dead Sea, *Dissolved oxygen, *Lakes, *Oxygen, *Saline lakes, *Solubility, *Water chemistry, Brines, Polarographic analysis, Temperature effects, Volumetric analysis, Winkler method.

Three analytical approaches were evaluated to determine the oxygen solubility in the Dead Sea waters (DSW) and the feasibility of using different analytical methods for determining the concentration of dissolved oxygen in this brine. The solubility of the oxygen in the Dead Sea brine was determined over the temperature range 5 to 50 C using a modified Winkler titration, volumetric analysis, and a polarographic sensor. The modified Winkler titration procedure is shown to be a reliable technique for measuring dissolved oxygen concentration in the highly saline DSW. At this time, the Clark type polarographic electrode is of value only for short duration dissolved oxygen measurements in DSW; its application for routine analysis is difficult. The solubility at room temperature and 1 atmosphere pressure was approximately 1 mg/L, and the temperature coefficient was 0.006 mg/L C. The data were nearly consistent with sea water solubility extrapolated to Dead Sea brine salinity. (Agostine-PTT)
W91-00744

VERNAL MICROSTRATIFICATION PATTERNS IN A MEROMICTIC SALINE LAKE: THEIR CAUSES AND BIOLOGICAL SIGNIFICANCE.
British Columbia Univ., Vancouver. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00745

PRODUCTION AND DECOMPOSITION IN A SALINE MEROMICTIC LAKE.
British Columbia Univ., Vancouver. Westwater Research Centre.
For primary bibliographic entry see Field 2H.
W91-00746

CHANGES IN LAKE LEVELS, SALINITY AND THE BIOLOGICAL COMMUNITY OF GREAT SALT LAKE (UTAH, USA), 1847-1987.
Geological Survey, Salt Lake City, UT.
For primary bibliographic entry see Field 2H.
W91-00748

PHOTOSYNTHESIS OF DUNALIELLA PARVA LERCHE AS A FUNCTION OF TEMPERATURE, LIGHT AND SALINITY.
Malaga Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W91-00750

COMPARATIVE LIMNOLOGY OF SAMBHAR AND DIDWANA LAKES (RAJASTHAN, NW INDIA).
Jodhpur Univ. (India). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00756

SALINITY AS A DETERMINANT OF SALT LAKE FAUNA: A QUESTION OF SCALE.
Adelaide Univ. (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00757

MULTIVARIATE ANALYSIS OF DIATOMS AND WATER CHEMISTRY IN BOLIVIAN SALINE LAKES.
Museume National d'Histoire Naturelle, Paris (France). Lab. de Geologie.
For primary bibliographic entry see Field 2H.
W91-00758

HYDROCHEMISTRY FROM SR AND MG CONTENTS OF OSTRACODES IN PLEISTOCENE LACUSTRINE DEPOSITS, BAZA BASIN (SE SPAIN).
Instituto de Investigaciones Geologicas Jaime Almera, Barcelona (Spain).
For primary bibliographic entry see Field 2H.
W91-00759

SPECTROSCOPIC INVESTIGATIONS OF PEAT-WATER INTERACTIONS: AN ESR, FT-IR, AND NMR STUDY.
Umea Univ. (Sweden). Dept. of Physical Chemistry.
For primary bibliographic entry see Field 2H.
W91-00789

SURVEY OF THE PROTEIN CONTENT IN ESTUARINE WATERS.
Cochin Univ. of Science and Technology (India). School of Marine Sciences.
For primary bibliographic entry see Field 2L.
W91-00795

WATER CHEMISTRY OF THE SOLIMOES/AMAZON RIVER (A HIDROQUIMICA DO RIO SOLIMOES/AMAZONAS).
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
U. M. Santos, and M. N. G. Ribeiro.
Acta Amazonica AAMZAZ, Vol. 18, No. 3/4, p 145-172, 1989. 8 fig, 2 tab, 29 ref. English summary.

Descriptors: *Amazon River, *Brazil, *Physicochemical properties, *Solimoes River, *Water chemistry, *Water quality, Humic substances, Oxygenation, Seasonal variation, Sediments.

Physical and chemical studies were conducted at 11 sites on the Solimoes/Amazon River and in thirty-one tributaries and branches from the Brazil-Peru-Columbia border, in Tabatinga, to the town of Santarem, in the state of Para. A total distance of 2457 km was covered. All the muddy water rivers form varzeas (rich humic lowlands formed during the low water period), which are rich in mineral nutrients and contain along lakes, paranas (branches of a river that conducts water downstream to the same river, or another river altogether), igapos (flooded forests) along their entire length. A large amount of floating vegetation is present which decomposes and produces toxic gases, such as hydrogen sulfide, methane, and carbon dioxide. The lakes and the varzea work as a 'sponge', absorbing suspended sediments, mineral and organic nutrients. The dark water rivers do not form varzeas, but rather beaches (dry season) and igapos (rainy season), due to the low amount of sediments. The dark color is due to colored substances, such as humic material, that limit the production of phytoplankton. The clear water rivers do not form varzeas either, but rather beaches with a few igapos. They show a blue-green color due to large formations of Cyanophyta. The muddy water rivers which contain higher concentrations of sediments during the period from November to April are supplied with resuspended sediments due to an increase in flow and partially due to the phenomenon of 'falling land'. It is possible that the Solimoes/Amazon River receives mineral and organic supplies from muddy water rivers, small rivers barraged in its mouth, rivers with small flushes of limestone, and rivers with large amounts of colored substances. The lowest temperatures in the Solimoes-Amazon River occur in the period of main channel flooding, while the highest occur in the summer. The lowest concentrations of oxygen occur during the period from April to July, and are due to oxidized water coming from varzeas and lakes. (Author's abstract)
W91-00820

DEGRADATION OF POLYPHENOLS IN FIVE PLANT SPECIES IN THE AQUATIC ENVIRONMENT (DEGRADACAO DE PLOIFENOIS EM CINCO ESPECIES VEGETAIS EM AMBIENTES AQUATICOS).
Convenio Eletronorte/CNPq/INPA, Brazil.
For primary bibliographic entry see Field 2H.
W91-00821

ATMOSPHERIC CHEMISTRY OF PEROXIDES: A REVIEW.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W91-00841

CHEMICAL COMPOSITION DIFFERENCES IN FOG AND CLOUD DROPLETS OF DIFFERENT SIZES.
California Inst. of Tech., Pasadena. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2B.
W91-00854

CHEMICAL STUDIES OF CHLORIDE AND STABLE OXYGEN ISOTOPES IN TWO CONIFER AFFORESTED AND MOORLAND SITES IN THE BRITISH UPLANDS.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W91-00890

CLASSIFICATION OF SHALLOW GROUNDWATER TYPES IN A DUTCH COVERSAND LANDSCAPE.
Amsterdam Univ. (Netherlands). Landscape and Environmental Research Group.
B. Pedroli.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 361-375, July 1990. 3 fig, 4 tab, 29 ref.

Descriptors: *Aquifers, *Geochemistry, *Groundwater chemistry, *Statistical analysis, *The Netherlands, *Water chemistry, Calcium, Chemical analysis, Classification, Cluster analysis, Data interpretation, Geohydrology, Groundwater level, Groundwater movement, Hydrogen ion concentration, Magnesium, Piezometers, Sand aquifers.

The numerical classification of shallow groundwater samples was determined on the basis of their chemical composition. Seven times in the course of one year, water was sampled from 50 piezometric tubes installed in a sandy lowland area of 20 square kilometers, used as a nature reserve and farming land. Water-table depth varies between 0 and 5 m below soil surface in the study area. A total of 416 samples was analyzed. Cluster analysis and subsequent discriminant analysis were applied to the log-transformed concentrations. Two subsets were considered, one with samples of $pH < 5$, the other with samples of $pH > 5$. In both cases the 8-cluster solution of a maximum likelihood clustering method appeared to be stable. The characteristics of the resulting 16 water types were readily interpretable with reference to landscape setting and temporal variation. The spatial distribution of the water types was mapped. The chemical composition of groundwater proved to be relatively constant over a large part of the area, owing to high inputs of mineralization products or fertilizers in the recharge areas. Variation was largest around the relatively small seepage area, in zones where infiltrating water interferes with discharging deep groundwater, comparable to Van Wirdum's poikilotrophic zones. Key factors for statistical classification of groundwater types differed depending on the nature of the water types considered. Mg appeared to discriminate better than Ca between the water types in both subsets. pH discriminated only in the near-neutral subset and the anions in the acid subset. (Author's abstract)
W91-00895

EFFECTS OF CATCHMENT LIMING AND AFFORESTATION ON THE CONCENTRATION AND FRACTIONAL COMPOSITION OF ALUMINUM IN THE LOCH FLEET CATCHMENT, SW SCOTLAND.
Stirling Univ. (Scotland). Dept. of Environmental Science.
For primary bibliographic entry see Field 5G.
W91-00897

METHOD TO EXTRACT SOIL WATER FOR STABLE ISOTOPE ANALYSIS.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2G.
W91-00898

2L. Estuaries

EFFECTS OF A FIXED-CREST WEIR ON BROWN SHRIMP PENAEUS AZTECUS GROWTH, MORTALITY, AND EMIGRATION IN A LOUISIANA COASTAL MARSH.
Louisiana State Univ., Baton Rouge. School of Forestry and Wildlife Management.
For primary bibliographic entry see Field 8I.
W91-00010

COMPARISON OF VESICULAR-ARBUSCULAR MYCORRHIZAE IN PLANTS FROM DISTURBED AND ADJACENT UNDISTURBED REGIONS OF A COASTAL SALT MARSH IN CLINTON, CONNECTICUT, USA.
Connecticut Univ., Storrs. Dept. of Ecology and Evolutionary Biology.
For primary bibliographic entry see Field 2I.
W91-00029

TIDES IN THE ENGLISH CHANNEL AND SOUTHERN NORTH SEA. A FREQUENCY DOMAIN ANALYSIS USING MODEL TEA-NL.
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
A. M. Baptista, J. J. Westerink, and P. J. Turner.
Advances in Water Resources AWREDI, Vol. 12, No. 4, p 166-183, December 1989. 16 fig, 8 tab, 25 ref. USGS Cooperative Agreement No. 13-08-001-A0510.

Descriptors: *Coastal waters, *English Channel, *Finite element method, *Mathematical models, *Model studies, *North Sea, *Tides, Data collections, Model testing, Performance evaluation, Water circulation.

The frequency-time finite element model TEA-NL (Non-linear Tidal Embayment Analysis) was used to investigate tidal propagation and circulation in the English Channel and the southern North Sea, in the context of the Tidal Flow Forum (TFF) benchmark. The nonlinear load terms were generated at each cycle of the iteration in the time domain using previously-computed harmonic responses. Major tidal propagation features were fairly well reproduced, except for sexto-diurnal constituents, which suffered from excessive spurious spatial oscillations. Results at control stations for elevations compared favorably with those obtained with other state-of-the-art circulation models, especially at Christchurch and Walton. An appropriate choice of internal parameters (Relaxation factor, tolerance criterion, number of auxiliary frequencies, and number of sampling points) was found to be critical for TEA-NL's computational efficiency: for different combinations, processing time (and, hence, computational cost) could vary by an order of magnitude without noticeable change in accuracy. The present representation of the 'sea truth' of the TFF database, at the boundaries and at the 11 control stations, raises questions of reliability and completeness (e.g., the database severely constrains the ability to study tidal nonlinearities in the system). (Medina-PTT)
W91-00045

COMPARISON OF TWO FINITE ELEMENT MODELS OF TIDAL HYDRODYNAMICS USING A NORTH SEA DATA SET.
Geological Survey, Tacoma, WA. Water Resources Div.
R. A. Walters, and F. A. Werner.
Advances in Water Resources AWREDI, Vol. 12, No. 4, p 184-193, December 1989, 9 fig, 1 tab, 19 ref. NSF Grant CEE-8352226.

Descriptors: *Finite element method, *Hydrodynamics, *Mathematical models, *Model studies, *North Sea, *Tides, Comparison studies, Data col-

lections, English Channel, Flow friction, Flow velocity.

The results of two independent finite-element models of tidal hydrodynamics, a time-stepping model and a harmonic model, were compared. The regions of the English Channel and the southern bight of the North Sea were used in the comparison. The model results were in close agreement with each other, and differed most in those areas of large current velocity and large velocity gradient such as the region near Cherbourg, France. In addition, comparison of the two models indicated that the nonlinear terms in the equations of motion can be properly treated in the frequency domain through a truncated series representation for bottom friction, and through a direct representation for the advective and wave-drift terms. It was also found that the use of high-order numerical quadrature schemes led to noisy and unacceptable results for the residual velocity. This model intercomparison provides a means for increasing the understanding of the relevant physical processes in the region in question as well as a means for the evaluation of certain algorithmic procedures of the two models. (Medina-PTT)
W91-00046

TIDAL FLOW SIMULATION IN THE ENGLISH CHANNEL AND SOUTHERN NORTH SEA.
Katholieke Univ. Leuven (Belgium). Dept. of Civil Engineering.
C. S. Yu, M. Fettweis, I. Hermans, and J. Berlamont.
Advances in Water Resources AWREDI, Vol. 12, No. 4, p 194-203, December 1989. 8 fig, 4 tab, 20 ref.

Descriptors: *Coastal waters, *English Channel, *Mathematical models, *Model studies, *North Sea, *Simulation, *Tidal currents, Bathymetry, Chezy equation, Data collections, Error analysis, Friction, Mannings equation, Sensitivity analysis, Tidal amplitude.

The results of the II ('revised') Tidal Flow Forum experiment for the English Channel and the southern North Sea are presented. The FADI (falsified alternating direction implicit) scheme and the data base of the Tidal Flow Forum were used for modeling. Discrepancies between the model results and the distributed field data of 11 tide stations and 8 tidal current measurement points were quantified by calculating the RMS (root mean square) errors and the standard deviations. Tidal amplitudes were generally underestimated except for one station. In order to investigate these discrepancies, experiments were carried out to test the sensitivity of the model to certain parameters. The influences of different coordinate systems, time steps, Chezy coefficient values, friction laws (Manning instead of Chezy), and the expression of the Coriolis acceleration were investigated. The results which best fit the reference data were obtained by using Manning's friction law. By doing so, the model can be more appropriately adapted to the complex bathymetry and geometry in the model area. This complexity is due to the presence of many sand banks and gullies in the southern North Sea and of many islands and tidal flats in the English Channel. (Medina-PTT)
W91-00047

SIMULATION OF THE TIDAL FLOW IN THE ENGLISH CHANNEL AND THE SOUTHERN NORTH SEA BY A CURVILINEAR FINITE DIFFERENCE MODEL.
Rijkswaterstaat, The Hague (Netherlands). Div. of Tidal Waters.
N. Praagman, J. Dijkzeul, R. van Dijk, and R. Plieger.
Advances in Water Resources AWREDI, Vol. 12, No. 4, p 204-210, December 1989. 5 fig, 1 tab, 13 ref.

Descriptors: *English Channel, *Finite difference methods, *Mathematical models, *Model studies, *North Sea, *Tidal currents, Coastal waters, Comparison studies, Model testing, Simulation, The Netherlands.

A curvilinear finite-difference model was used to simulate tidal flow in the southern North Sea and the English Channel and its results were compared with those from linear finite differences models. This mathematical model was developed primarily for the simulation of flood levels in the major Dutch rivers but, through the use of deformed meshes, it also seemed appropriate for computing flow patterns and water elevations in coastal areas. The model also permitted locally increasing the density of computational points in order to represent local flow patterns and elevations more accurately. In general, the results of the curvilinear model were at least as accurate as the results of the linear models. However, the number of computational points was increased by a factor of 1.5 and the computation time increased by a factor of 3 due to these extra points and to the calculation of the extra terms and coefficients in the curvilinear equations. Thus, the advantages over the linear method are not as evident in this application as they are in the case of river computations. (Medina-PTT)
W91-00048

GEOMORPHOLOGICAL EFFECTS OF CATASTROPHIC FLOODING ON A SMALL SUBTROPICAL ESTUARY.
Council for Scientific and Industrial Research, Congella (South Africa). Estuaries and Coastal Processes Programme.
For primary bibliographic entry see Field 2J.
W91-00049

ECOLOGY OF MARINE BENTHIC DIPTERANS IN A TIDAL CREEK OF HOOGHLY ESTUARY, SAGAR ISLAND, INDIA.
Calcutta Univ. (India). Dept. of Marine Science.
S. Ray, and A. Choudhury.
Journal of Bengal Natural History Society, Vol. 9, No. 1, p 4-14, June 1990. 3 fig, 3 tab, 12 ref.

Descriptors: *Aquatic insects, *Ecological distribution, *Estuaries, *Estuarine ecosystems, *India, *Marine animals, *Tidal rivers, Rainfall, Salinity, Soil organic matter, Soil temperature, Soil water.

Larvae and pupae of marine benthic Diptera were sampled from the sand flats of a tidal creek of Hooghly estuary, Sagar Island. A total of 14 species of dipterans belonging to 5 families and 11 genera were recorded. Ceratopogonids were the most dominant fauna followed by ephydrids, tabanids, chironomids and psychodids. Soil moisture, soil temperature, rainfall, and salinity appear to be major factors controlling their distribution and abundance in the littoral habitat as evident from correlation coefficient analysis. Correlation data also indicate a direct relationship between organic nutrients and abundance of some species. (Medina-PTT)
W91-00051

PROPAGATION OF PERIODIC WAVES IN THE LIDO CHANNEL OF THE VENICE LAGOON.
F. Mattioli.
Advances in Water Resources AWREDI, Vol. 13, No. 1, p 41-48, March 1990. 11 fig, 21 ref.

Descriptors: *Finite element method, *Italy, *Lido Channel, *Mathematical models, *Model studies, *Periodic waves, *Venice Lagoon, *Wave propagation, Wave action, Wave refraction.

An elliptical approach to numerical modeling of the propagation of periodic waves in the Lido Channel, connecting the Adriatic sea to the Venice lagoon, was enhanced by the use of a finite element, series-expansion technique. The main numerical difficulties arose from the large size of the sea region to be modeled, which was on the order of 1 sq km, and from the wide variations in water depth. The wave field was evaluated both in the presence and absence of a breakwater which partially closes access to the lagoon. Since the model is linear, only a crude representation of the shallow sea regions was possible. Nevertheless, the model was able to answer problems that could not be easily handled by other techniques, because of the complicated interaction of refraction, reflection and diffraction phenomena. (Author's abstract)
W91-00121

LONGSHORE-TRANSPORT MODEL FOR SOUTH INDIAN AND SRI LANKAN COASTS.
National Inst. of Oceanography, Panaji (India).
P. Chandramohan, B. U. Nayak, and V. S. Raju.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 116, No. 4, p 408-424, July/August 1990. 8 fig, 1 tab, 16 ref.

Descriptors: *Coastal engineering, *Coasts, *Erosion rates, *India, *Longshore currents, *Sediment transport, *Sedimentation rates, *Silting, *Sri Lanka, Estuarine sediments, Littoral drift, Tidewater.

The Indian coastline has direct bearing on the socioeconomic development of the nation's sea trade, fishing and marine industry, and human settlement. Erosion near the ports and siltation in most of the tidal inlets is of great concern to Indian coastal engineers. Longshore sediment transport rates for the south Indian coast from Allur to Cochin and for Sri Lanka were estimated from ship-reported wave data (1968-1986). Annual gross sediment transport rate is high (1,500,000 to 2,000,000 cu m) along the coasts of north Tamil Nadu and south Kerala and is less (500,000 to 1,000,000 cu m) along the south Tamil Nadu and Sri Lankan coasts. The annual net transport is southerly along the west coast of India and predominantly northerly along the east coast except near Durgarajupatnam in Andhra Pradesh. Coasts near Tharangampadi, Karaikal, Nagore, Tuticorin, Virapandianpatinam, and Manakkodam in India and Kuchchaveli, Betticola, Pottuvil, Chilaw, and Negombo in Sri Lanka appear to be nodal drift points, with an equal volume of transport in either direction annually. (Fish-PTT)
W91-00176

IMPROVEMENT OF BYPASSING AND BACKPASSING AT TIDAL INLETS.
For primary bibliographic entry see Field 8A.
W91-00178

OPTIMIZATION OF FRESHWATER INFLOW TO ESTUARIES.
Wyoming Univ., Laramie. Water Resources Research Inst.
Y. K. Tung, Y. Bao, L. W. Mays, and G. Ward.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 567-584, July/August 1990. 9 fig, 5 tab, 7 ref, append.

Descriptors: *Estuaries, *Freshwater, *Model studies, *Optimization, *Saline-freshwater interfaces, *Water resources management, Estuarine fisheries, Fish harvest, Nonlinear programming, Regression analysis, Saline water intrusion, Shrimp, Texas.

A method has been developed that can be used to determine the optimal freshwater inflows into bays and estuaries for the purpose of balancing freshwater demands with the harvest of various types of estuarine resources (e.g., finfish and shrimp). The optimization problem is a nonlinear programming problem solved using a generalized reduced gradient technique. Salinity is expressed as a function of freshwater inflow in a nonlinear regression equation and used as a constraint. Additional nonlinear constraints are the harvest regression equations for the various species that express harvest as a function of the quantity of freshwater inflow. Because of the uncertainty associated with the regression equations for salinity and harvest, these constraints are expressed in a chance-constrained formulation. The method was applied to the Lavaca-Tres Palacios Estuary in Texas. The results indicated that the minimum freshwater inflow requirement increases as the required reliability of chance constraints increases. The uncertainty in the regression equations limits the maximum achievable reliability. (Author's abstract)
W91-00187

POTENTIAL FOR AGRICULTURAL PESTICIDE RUNOFF TO A PUGET SOUND ESTUARY: PADILLA BAY, WASHINGTON.
Western Washington Univ., Bellingham. Inst. for Watershed Studies.
For primary bibliographic entry see Field 5B.
W91-00204

BENTHIC MACROFAUNA AND ANCILLARY DATA FOR SAN FRANCISCO BAY, CALIFORNIA, JANUARY TO NOVEMBER 1988.
Geological Survey, Sacramento, CA.
L. E. Schemel, A. Y. Ota, J. G. Harmon, J. M. Shay, and R. M. Adorador.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 89-596, 1990. 65p, 1 fig, 7 tab, 9 ref. Prepared in cooperation with the California State Water Resources Control Board.

Descriptors: *Benthic fauna, *California, *Estuarine environment, *Physicochemical properties, *San Francisco Bay, *Suspended sediments, Introduced species, Monitoring, Salinity, Species composition, Water temperature.

Benthic macrofauna and ancillary data were collected during 1988 as part of the U S Geological Survey Regional Effects Monitoring Program in San Francisco Bay, California. Data were collected during six cruises at 2-month intervals from January to November. Benthic macrofauna for identification and counting of species and sediments for size analysis were collected at eight stations. Temperature, salinity, and concentrations of dissolved oxygen and suspended sediment were measured at 12 stations. Salinity was measured at three stations that coincided with continuous monitoring stations. The percentage of benthic macrofauna specimens that could be identified to the species level varied among sampling stations. Based on annual averages at each station, this percentage ranged from 60 to 95 percent. Three or fewer species represented from 25 to 75 percent of the total number of specimens at all stations. This percentage changed over time, as did the species. The annual average number of species per sample ranged from 4 to 21. Stations in the southern bay were typically higher in number of species and number of specimens per sample than those in the northern bay. The newly introduced species of clam, Potamocorbula amurensis, persisted as an abundant species in the northern bay, and became more abundant at all stations in the southern bay except one. (Author's abstract)
W91-00343

LOCATING AND IDENTIFYING HYDRAULIC CONTROLS FOR LAYERED FLOW OVER AN OBSTRUCTION.
California Univ., Berkeley. Dept. of Civil Engineering.
R. A. Denton.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 281-299, 1987. 9 fig, 2 tab, 23 ref. NSF Grant CEE-8212073.

Descriptors: *Fjords, *Hydraulics, *Mathematical models, *Model studies, *Saline-freshwater interfaces, *Stratified flow, Hydraulic grade, Hydraulic models, Mathematical analysis, Mathematical equations.

The density stratification in a fjord can be approximated as a shallow layer of brackish water overlying a layer of ocean water. During the period of maximum tidal currents the flow over the fjord sill can become critical with respect to the first mode internal wave and produce, internally, a flow very similar to the classical case of critical control of open-channel flow over a hump. The build-up of internal energy upstream of the flow obstruction is dissipated downstream through interfacial mixing. A methodology is presented for locating the hydraulic controls for layered flow, when both the bed elevation and flow width are varying. The model is, based on singular points in the solution of the gradually varying flow equations for the free surface and interface slopes. The hydraulic control of two-layer flow through an obstruction can be explained in terms of the gradually varying flow equation for the interface slope. The controls occur at a transition from subcritical to supercritical flow and the interface can remain smooth and continuous if the control corresponds to a singular point of the saddle kind. Because of the interaction of the variations in flow width and bottom elevation in the obstruction, the type of control changed from maximum constriction control to virtual and approach control as the flow rates or flow constriction increased. The control for two-layer flow in one direction through an obstruction with asymmetric geometry is generally different than the control when the flow is in the opposite direction. This is more complicated than single-layer flow where only maximum constriction control is possible. Although friction effects have been neglected in the two-layer analysis, interfacial and bottom friction can alter the transition curves and thereby change the location of the hydraulic control. (Hoskin-PTT)
W91-00374

DISTRIBUTIONS AND POPULATION STRUCTURES OF TWO INTERTIDAL ESTUARINE POLYCHAETES IN THE LOWER ST. LAWRENCE ESTUARY, WITH SPECIAL REFERENCE TO ENVIRONMENTAL FACTORS.
Quebec Univ., Rimouski. Dept. of Oceanography.
G. Y. Miron, and G. L. Desrosiers.
Marine Biology MBIOAJ, Vol. 105, No. 2, p 297-306, June 1990. 6 fig, 57 ref. NSERC Canada Grant No. A3450.

Descriptors: *Ecological distribution, *Estuarine environment, *Estuarine sediments, *Polychaetes, *Spatial distribution, *St Lawrence Estuary, *Water pollution effects, Aquatic populations, Intertidal areas, Model studies, Seasonal variation, Statistical analysis.

An intensive study of the spatial distribution of Nereis virens (Sars) and Nephtys caeca (Fabricius) was conducted during the spring and autumn of 1986 in the lower St. Lawrence estuary. Statistical analysis showed that spatial variations in density, individual body weight and sexual maturity, particularly in the case of N. virens, are correlated with the intertidal level, with certain sediment characteristics, and with the thickness of the colonizable sediment layer. The density of N. virens increases in an offshore-onshore direction, whereas that of N. caeca decreases in the same direction. For both species, mean body weight increases downshore from the upper intertidal level. Other specific relationships exist in relation to sediment characteristics. Sexually mature N. virens are found only at the lower intertidal level; sexual maturity in N. caeca was not studied. There were no changes in spatial distribution patterns between spring and autumn. The spatial distribution of N. virens parallels depth contours and may reflect its ability to inhabit environments which become more physically unstable in an offshore-onshore direction. This spatial distribution is consistent with a model whereby larvae are recruited in the upper intertidal zone and juveniles migrate downshore. (Author's abstract)
W91-00383

EFFECTS OF WASTES ON THE OCEAN: THE COASTAL EXAMPLE.
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-00385

POTENTIAL FOR ADAPTATION OF THE ESTUARINE COPEPOD EURYTEMORA AFFINIS TO CHLORINE-PRODUCED OXIDANT RESIDUALS, HIGH TEMPERATURE, AND LOW OXYGEN.
Maryland Univ. Baltimore County, Catonsville. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W91-00512

MULTILAYERED SHARP INTERFACE MODEL OF COUPLED FRESHWATER AND SALTWATER FLOW IN COASTAL SYSTEMS: MODEL DEVELOPMENT AND APPLICATION.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2F.
W91-00591

EFFECT OF TIDAL ACTION ON THE TRANSFORMATIONS OF NITROGEN IN FRESHWATER TIDAL FLAT SEDIMENTS.
Hamburg Univ. (Germany, F.R.). Fachbereich 14 - Biologie.
For primary bibliographic entry see Field 5B.
W91-00649

SEASONAL VARIATION IN THE STRUCTURE OF THE MICROBIAL COMMUNITY CAPABLE OF NITRATE RESPIRATION IN AN INTERTIDAL MUD FLAT SEDIMENT FROM THE ELBE ESTUARY.
Hamburg Univ. (Germany, F.R.). Fachbereich 14 - Biologie.
M. Kerner.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 75, No. 2, p 273-280, 1990. 4 fig, 17 ref.

Descriptors: *Cycling nutrients, *Germany, *Microorganisms, *Nitrates, *Sediments, *Tidal flats, Elbe River, Estuaries, Metabolism, Oxygen, Respiration, Seasonal variation, Temperature.

Temperature-dependent nitrate consumption was determined in a suspension system from the sediment surface layers of an intertidal mud flat sediment in the Elbe Estuary. Sediment samples from depths of 0-2, 2-4, 6-8, and 10-12 cm were incubated under oxygen-free conditions at various temperatures in 2.7-C intervals from 5 to 40 C, and the changes in the concentrations of nitrate were monitored for three hours. From 5 to 11 C, only small changes in respiration rates during the year were found for the sediment layers from the surface to the depth of 12 cm. At 11 C the average rate determined for the sediment surface was 0.00297 micromole/gsec, whereas for the 2-4 cm layer the value was 0.00202 micromole/gsec. Below 4 cm, the average rate was 0.00077 micromole/gsec. In winter no optimum temperature was found for nitrate respiration in the sediment from the surface to the lowest depth tested. Until November, bacteria adapted to the warmth became dominant among those using nitrate for respiration. A single temperature optimum of 32 C was found for the surface layer. In the sediment layers deeper than 4 cm, there were only small changes in the capacity of the microbial community for nitrate respiration during the year, and an optimum temperature was never found. (See also W91-00649) (Author's abstract)
W91-00650

POTENTIAL BIO-AVAILABLE PHOSPHORUS IN SEDIMENTS OF THE RIVER ELBE IN NORTHERN GERMANY.
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Chemie.
K. Wiltshire.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 75, No. 2, p 281-297, 1990. 14 fig, 2 tab, 36 ref. EEC Contract EU40-0124-CBA.

Descriptors: *Cycling nutrients, *Elbe River, *Estuaries, *Germany, *Phosphorus, *Sediments, Anaerobic conditions, Muhlenberger Loch, Neufelder Watt, Oxygen.

Sediments from the Muhlenberger Loch (633 km) and Neufelder Watt (703 km) were obtained from the River Elbe and subjected to a sequential extraction scheme. The types and amounts of different phosphorus species were assessed. The fraction characterization was done according to the solution properties of the various phosphorus components. The non-apatite, easily soluble, fractions were classed as potentially bio-available compounds. They accounted for up to 80% of the total extractable phosphorus present. To allow an assessment of extraction fractions sensitive to the

presence of oxygen, the relevant extraction steps were carried out under anaerobic and aerobic conditions. Under anaerobic conditions the more easily extractable compounds were extracted to a significantly higher degree than under aerobic conditions. (Author's abstract)
W91-00651

PHYSICOCHEMISTRY AND VEGETATION OF PICCANINNIE PONDS, A COASTAL AQUIFER-FED POND IN SOUTH-EASTERN SOUTH AUSTRALIA.
Monash Univ., Clayton (Australia). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W91-00653

ESTIMATING THE CARRYING CAPACITY OF A COASTAL INLET FOR MUSSEL CULTURE.
Department of Fisheries and Oceans, Halifax (Nova Scotia). Biological Sciences Branch.
C. E. A. Carver, and A. L. Mallet.
Aquaculture AQCLAL, Vol. 88, No. 1, p 39-53, July 1990. 6 fig, 2 tab, 36 ref.

Descriptors: *Carrying capacity, *Coastal waters, *Fisheries, *Growth, *Mussels, Aquatic habitats, Organic matter, Particulate matter, Tidal basins.

Carrying capacity, in the context of mussel culture, may be defined as the stock density at which production levels are maximized without negatively affecting growth rates. Preliminary estimates were made of the carrying capacity for a small (0.5 sq km) semi-enclosed coastal inlet located on the eastern shore of Nova Scotia, Canada. The food supply to the system was determined from measurements of tidal exchange and particulate organic matter (POM) over the period of May to October 1986. The food demand, or the mussels' ration, was estimated from grazing experiments conducted in the field. Filtration rates were obtained for mussels feeding on the natural particle spectrum, without subjecting the inflowing water to disruptive pump action. Estimates of the mussels' daily ration (11 to 41 mg POM/mussel/day) were lower than those from other field studies, but comparable to laboratory-derived values. Food supply (gm POM/week) was divided by food demand (gm POM/kg mussels/week) to obtain weekly estimates of carrying capacity for the system. These values ranged from 200,000 to 600,000 kg of market-size mussels (> 50 mm) depending on temporal variations in the food supply. (Author's abstract)
W91-00666

ECOLOGY OF A MEDITERRANEAN-CLIMATE ESTUARINE WETLAND AT CARPINTERIA, CALIFORNIA: PLANT DISTRIBUTIONS AND SOIL SALINITY IN THE UPPER MARSH.
California Univ., Santa Barbara. Dept. of Biological Sciences.
R. M. Callaway, S. Jones, W. R. Ferren, and A. Parikh.
Canadian Journal of Botany CJBOAW, Vol. 68, No. 5, p 1139-1146, May 1990. 7 fig, 3 tab, 44 ref.

Descriptors: *California, *Ecological distribution, *Estuaries, *Limnology, *Marsh plants, *Saline soils, *Salinity, *Salt marshes, *Wetlands, Ecology, Marshes, Seasonal variation, Soil chemistry, Species composition.

Seasonal changes in soil salinity in four different vegetative zones in a mediterranean-climate estuarine wetland in southern California were studied. Each zone had a characteristic seasonal pattern of soil salinity: (1) the low marsh zone was high in salinity throughout the year; (2) the salt flat zone was hypersaline throughout the year; (3) the transition zone was hypersaline in the summer and fall, and low in salinity in the winter and spring; and (4) the non-flooded grassland was low in salinity throughout the year. The transition zone was densely populated with winter annuals that were distributed along gradients of elevation and soil salinity. This occurrence of annuals is a characteristics feature of mediterranean-climate marshes. The relative growth rates and the germination of each of these annuals in experimental solutions of different salinities corresponded with the winter and spring soil salinities of the subzones they occupied in the field. (Author's abstract)
W91-00675

PILOT STUDIES FOR DESIGNS OF SURVEYS OF HUMAN DISTURBANCE OF INTERTIDAL HABITATS IN NEW SOUTH WALES.
Sydney Univ. (Australia). Inst. of Marine Ecology.
For primary bibliographic entry see Field 4C.
W91-00685

MICROPHYTOPLANKTON OF UPWELLING COASTAL WATERS (STATE OF RIO DE JANEIRO): LIST OF SPECIES AND ECOLOGICAL ASPECTS (O MICROFITOPLANCTON DAS AGUAS COSTEIRAS DO LITORAL FLUMINENSE (ESTADO DO RIO DE JANEIRO)): LISTA DE ESPECIES E ASPECTOS ECOLOGICOS.
Instituto Nacional de Estudos do Mar, Arraial do Cabo (Brazil).
N. M. Linsda Silva, J. L. Valentin, and C. T. B. Bastos.
Boletim do Instituto Oceanografico BOCNAO, Vol. 36, No. 1/2, p 1-16, 1988. 8 fig, 4 tab, 21 ref. English summary.

Descriptors: *Brazil, *Ecosystems, *Phytoplankton, *Species composition, *Upwelling, Algal growth, Cyanophyta, Detritus, Statistical analysis.

Phytoplankton of the coastal water between Cabo Frio and Rio de Janeiro were studied at the upwelling season (October, January, and March). Qualitative and quantitative variations are analyzed in function of the hydrological conditions by means of a multivariate statistical treatment of data. Cabo Frio upwelling is responsible for occurrence of a thermocline in the euphotic layer which induces phytoplankton growth, beginning with small-sized species (Nitzschia sp., Skeletonema costatum) and progressing to a high diversity and quantity of microphytoplanktonic forms (Guinardia, Rhizosolenia, Chaetoceras, Thalassiothrix). When the water column is sharply stratified, the influence of Guanabara Bay was observed in the high growth of Skeletonema costatum and high quantity of detritus together with blue-green algae and nanoplanktonic forms. (Author's abstract)
W91-00689

BIOLOGY AND ECOLOGY OF BRACHYURAN DECAPOD CRUSTACEANS IN THE BAY/ESTUARY SYSTEM OF SANTOS AND SAO VINCENTE (SAO PAULO): 1. OCCURRENCE AND SPECIES COMPOSITION (BIOECOLOGIA DE CRUSTACEOS DECAPODOS, BRAQUIUROS, NO SISTEMA BAIA-ESTUARIO DE SANTOS E SAO VINCENTE, SP: 1. OCORRENCIA E COMPOSICAO).
Sao Paulo Univ. (Brazil). Inst. Oceanografico.
P. S. Moreira, A. M. Paiva Filho, C. M. Okida, J. M. M. Schmiegelow, and R. Giannini.
Boletim do Instituto Oceanografico BOCNAO, Vol. 36, No. 1/2, p 55-62, 1988. 4 fig, 2 tab, 18 ref. English summary.

Descriptors: *Crustaceans, *Ecosystems, *Estuaries, *Population dynamics, *Species composition, Sex ratio, Spatial distribution, Water temperature.

Monthly sampling was performed from June 1985 to May 1986 in estuarine and coastal adjacent habitats. Samples were collected using bottom trawls, beach seines, and bottom pots. Fourteen species (6538 individuals) of decapod brachyurans were identified. Callinectus danae was the most abundant species in all habitats, followed by Callinectes sapidus and Portunus spinimanus. Bottom trawling proved to be the most effective fishing technique, catching fourteen species, while the beach seine technique caught eight species and estuarine catches with bottom pots caught five species (all Callinectes). The number of females was higher than males for all dominant species and, generally, this number was higher in the bay region than in either the beach or estuarine habitats. The increase in total catches during the spring and summer months may be correlated with warmer waters and reproduction patterns. (Author's abstract)
W91-00690

ARSENATE SENSITIVITY IN MARINE PERIPHYTON COMMUNITIES ESTABLISHED UNDER VARIOUS NUTRIENT REGIMES.
Goeteborg Univ. (Sweden). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W91-00700

NEGATIVE OXYGEN TRENDS IN SWEDISH COASTAL BOTTOM WATERS.
Kristenebergs Marinbiologiska Station, Fiskebackskil (Sweden).
For primary bibliographic entry see Field 2K.
W91-00703

COMPARATIVE DATA ON PRIMARY PRODUCTIVITY AND MINERAL PHOSPHORUS UPTAKE IN THE EUPHOTIC ZONE OF THE MEDITERRANEAN AND BLACK SEA.
Institutul Roman de Cercetari Marine, Constanta (Romania).
A. S. Bologa, A. V. Parkhomenko, and V. Smocov.
Cercetari Marine: Recherches Marines CMARDQ, Vol. 19, p 7-21, 1986. 2 fig, 2 tab, 19 ref.

Descriptors: *Black Sea, *Mediterranean Sea, *Nutrients, *Phosphorus, *Primary productivity, Comparison studies, Euphotic zone, Metabolism, Phytoplankton.

Data on phosphorus in the Mediterranean and Black Seas were collected during the 19th cruise of R/V Professor Vodyanitskiy. Collections of sea water were made in the Strait of Sicily (two sectors), Balearic Sea, Aegean Sea, and Black Sea off Cape Caliacra. During May-July 1985, the planktonic productivity of four different sectors of the Mediterranean Sea ranged between 0.5 and 11.3 mg C/cu m/day and 0.06 to 0.48 g C/sq m/day, and in one sector of the Black Sea between 9.4 to 14.7 and 0.78, respectively. Similar phosphate-P concentrations in the water column to 90 were found. The P concentration in the euphotic zone (i.e., to 90 m) did not exceed 0.016 microgram/L in the Mediterranean nor 0.013 microgram/L in the Black Sea. The maximum rate of assimilation of P by microplankton communities in the Mediterranean occurred at the lower limit of the euphotic zone, but in the Black Sea it was within the euphotic zone at approx 10 m depth. (Author's abstract)
W91-00710

SOME PRELIMINARY DATA ON THE NUTRIENT INFLUX INTO THE WESTERN BLACK SEA.
Water Management Office, Constanta (Romania).
For primary bibliographic entry see Field 5B.
W91-00712

IMPACT OF HEAVY METALS ON THE PRIMARY PRODUCTION.
Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W91-00713

NITROGENOUS NUTRIENT TRANSFORMATIONS IN THE SPRING AND FALL IN THE CHESAPEAKE BAY.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
S. G. Horrigan, J. P. Montoya, J. L. Nevins, J. J. McCarthy, and H. Ducklow.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 30, No. 4, p 369-391, April 1990. 6 fig, 4 tab, 40 ref. NSF Grant OCE-82-14932.

Descriptors: *Chesapeake Bay, *Cycling nutrients, *Nitrogen cycle, *Plankton, Algae, Anaerobic conditions, Bacteria, Chlorophyll a, Dissolved oxygen, Isotope studies, Nitrogen isotopes, Seasonal variation, Tracers.

Measurements of the standing stock of phytoplankton, bacterioplankton and particulate carbon and nitrogen, and dissolved pools of inorganic nitrogen were made at a series of stations located in the main channel of the Chesapeake Bay during cruises in the spring and fall of 1984. On each cruise, two transects were conducted along the long axis (N-S) of the bay; comparison of these transects revealed that the horizontal and vertical distribution of O2, chlorophyll a, and dissolved inorganic N can change dramatically on a time scale of days. Experiments were carried out with 15N-labelled substates (NO2(-), NO3(-), and NH4(+) at a subset of the stations. These experiments were designed to measure the fluxes of nitrogen between the dissolved pools as well as the flux into particles. During the spring cruise, a surprisingly high rate of uptake of NO2(-) by particles was found. In the fall, uptake by particles followed previously reported patterns more closely. The flux of N between dissolved inorganic pools was often greater than the flux into particles. The rate of individual reactions varied spatially, and significant activity throughout the water column was often found. The occurrence of typically anaerobic reactions in well-oxygenated waters suggests that anaerobic microzones may be an important site for N transformations in the bay. The present results indicate that the rates of a number of microbially-mediated processes were enhanced greatly by storm-induced mixing of the water column during the fall cruise. Such transient enhancements may have large, and usually undocumented, effect on the N cycle. (See also W91-00719) (Author's abstract)
W91-00718

NATURAL ISOTOPIC COMPOSITION OF DISSOLVED ORGANIC NITROGEN IN THE CHESAPEAKE BAY.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
S. G. Horrigan, J. P. Montoya, J. L. Nevins, and J. J. McCarthy.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 30, No. 4, p 393-410, April 1990. 5 fig, 1 tab, 36 ref. NSF Grant OCE-82-14932.

Descriptors: *Chesapeake Bay, *Cycling nutrients, *Nitrogen isotopes, *Phytoplankton, Anaerobic conditions, Denitrification, Organic compounds, Seasonal variation.

The natural abundances of N15 in the dissolved inorganic pools of N in the Chesapeake Bay were measured in the spring and fall of 1984. Changes in the delta N15 of ammonium and the combined pool of nitrate plus nitrite reflected both seasonal and short-term changes in the estuarine N cycle. In the spring, oxidation of ammonium at the head of the bay in the region of the turbidity maximum and in localized regions throughout the bay led to elevated values of delta N15 in the ammonium pool. The delta N15 of the nitrate plus nitrite pool tended to increase toward the south, enabling an estimate of the isotopic fractionation factor for the consumption of nitrate to be derived. The estimate (1.0070), is similar to literature values of the fractionation factor for nitrate uptake by phytoplankton, supporting previous research suggesting that phytoplankton uptake is the major sink for nitrate in the bay. Denitrification led to elevated values of delta N15 in the nitrate plus nitrite pool in deep water. Over the course of the summer, the delta N15 of ammonium increased throughout the bay. A significant correlation was found between the delta N15 of the ammonium pool and the concentration nitrite both above and below the pycnocline during the fall cruise, suggesting that the increase in the delta N15 of the ammonium pool was due to the oxidation of ammonium. In the fall, changes also were observed in the delta N15 of both the ammonium and nitrate plus nitrite pools that were consistent with the occurrence of ammonium oxidation. From these changes, a fractionation factor for ammonium oxidation between 1.0120 and 1.0167 was derived, which is similar to published values. (See also W91-00718) (Author's abstract)
W91-00719

QUALITATIVE AND NUMERICAL ANALYSES OF THE EFFECTS OF RIVER INFLOW VARIATIONS ON MIXING DIAGRAMS IN ESTUARIES.
Carnegie Institution of Washington, DC. Geophysical Lab.
L. A. Cifuentes, L. E. Schemel, and J. H. Sharp.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 30, No. 4, p 411-427, April 1990. 8 fig, 1 tab, 26 ref. NOAA Grant NA83AA-d-0017.

Descriptors: *Estuaries, *Mixing, *River flow, *Water chemistry, Advection, Alkalinity, California, Delaware Bay, Dispersion, Mathematical equations, Numerical analysis, Qualitative analysis, Salinity, San Francisco Bay, Simulation, Theoretical analysis.

The effects of river inflow variations on alkalinity/salinity distributions in San Francisco Bay and nitrate/salinity distributions in Delaware Bay were examined. One-dimensional, advective-dispersion equations for salinity and the dissolved constituents were solved numerically and used to simulate mixing in the estuaries. These simulations account for time-varying river inflow, variations in estuarine cross-sectional area, and longitudinally varying dispersion coefficients. The model simulated field observations better than models that use constant hydrodynamic coefficients and uniform estuarine geometry. Furthermore, field observations and model simulations were consistent with theoretical 'predictions' that the curvature of property-salinity distributions depends on the relation between the estuarine residence time and the period of river concentration variation. (Author's abstract)
W91-00720

EFFECT OF H2S ON HETEROTROPHIC SUBSTRATE UPTAKE, EXTRACELLULAR ENZYME ACTIVITY AND GROWTH OF BRACKISH WATER BACTERIA.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
H. G. Hoppe, K. Gocke, and J. Kuparinen.
Marine Ecology Progress Series MESEDT, Vol. 64, No. 1/2, p 157-167, June 28, 1990. 4 fig, 4 tab, 29 ref. DFG Grant 715/3-2.

Descriptors: *Baltic Sea, *Dissolved oxygen, *Heterotrophic bacteria, *Hydrogen sulfide, Anaerobic conditions, Brackish water, Carbon isotopes, Isotope studies, Metabolism, Tracers.

In some parts of the Baltic Sea, establishment of anoxia, H2S accumulation, and reaeration of the water column are common processes that have a bearing on the heterotrophic microbial community. The influence of these conditions on natural aerobic bacteria populations was studied in 24-hr batch cultures. Measured parameters were: saprophyte number and total number of bacteria, active bacteria (leucine microautoradiography), heterotrophic substrate uptake (14C-labeled glucose, leucine, and lactate), extracellular enzyme activity (beta-glucosidase and peptidase), and growth of bacteria (3H-methyl thymidine incorporation). Anoxia established by N2 had a minor effect on these parameters and values approximated those from the oxic control within one incubation period. Addition of H2S led immediately to a strong, but variable, reduction in all the activity measurements and recovery was weak when H2S conditions were maintained over the experimental period. Re-aeration after 12 hr of H2S incubation caused a progressive increase of the activity measurements, which then greatly exceeded those from the continuously oxic control. An exception was peptidase, which recovered only slowly after H2S depletion. Short-term application of H2S caused clear changes in the metabolic and community structure of the originally aerobic bacterial population, which also were documented by a reduction of the spectrum of morphological cell characters. Cells that survived H2S stress developed vigorously after H2S depletion. Values of bacterial production calculated from increases in absolute bacterial numbers and from thymidine uptake showed the same tendency, but their absolute values differed considerably. This discrepancy may indicate that after H2S stress many of the surviving cells were reactivated, but only a fraction of these started reproduction. (Author's abstract)
W91-00730

INFLUENCE OF SALINITY ON THE CONCENTRATION AND RATE OF INTERCHANGE OF DISSOLVED PHOSPHATE BETWEEN WATER AND SEDIMENT IN FUENTE PIEDRA LAGOON (S. SPAIN).
Malaga Univ. (Spain). Facultad de Ciencias.
V. Clavero, J. A. Fernandez, and F. X. Niell.
Hydrobiologia HYDRB8, Vol. 197, p 91-97, May 31, 1990. 5 fig, 3 tab, 22 ref. Spanish Commission Interministery of Science and Technology Grant PB86-0677.

Descriptors: *Chemical properties, *Cycling nutrients, *Lagoons, *Lakes, *Phosphates, *Salinity, *Sediments, *Spain, *Water chemistry, Dissolved solids, Kinetics, Phosphate removal, Saline lakes.

Relationships between water and sediment have been recognized as important factors in the phosphorus cycle of fresh and seawater systems. Fluxes between water and sediment are influenced by physical, chemical and biological factors. The influence of salinity in: (a) the kinetics of phosphate interchange between water and sediment, and (b) the final equilibrium phosphate concentration in water with different salinities were investigated using sediment as the source of phosphate. Short (60 minutes) and long term (3 hours) experiments were performed to measure the final equilibrium concentration in water and the net fluxes of phosphate interchange between water and sediment at different salinities. The rate of phosphate release from the sediment increased with the salinity increment, as well as the final phosphate concentration. In both short and long term experiments the net rate of dissolved phosphate removal followed saturation kinetics except for long term experiments at 70 g/L salinity. In this case, the relationship between net removal and dissolved phosphate concentration was linear. The experiments show that salinity stimulates phosphate release from sediment. (Agostine-PTT)
W91-00743

PHOTOSYNTHESIS OF DUNALIELLA PARVA LERCHE AS A FUNCTION OF TEMPERATURE, LIGHT AND SALINITY.
Malaga Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W91-00750

HYDROCHEMISTRY FROM SR AND MG CONTENTS OF OSTRACODES IN PLEISTOCENE LACUSTRINE DEPOSITS, BAZA BASIN (SE SPAIN).
Instituto de Investigaciones Geologicas Jaime Almera, Barcelona (Spain).
For primary bibliographic entry see Field 2H.
W91-00759

INFLUENCE OF SEWAGE POLLUTION ON A ROCKY INTERTIDAL COMMUNITY DOMINATED BY THE MYTILID BRACHIDONTES RODRIGUEZI.
Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Buenos Aires.
For primary bibliographic entry see Field 5C.
W91-00764

EFFECTS OF CHANGES IN SEWAGE POLLUTION ON SOFT-BOTTOM MACROFAUNA COMMUNITIES IN THE INNER OSLOFJORD, NORWAY.
Tromsoe Univ. (Norway). Inst. of Fisheries.
For primary bibliographic entry see Field 5C.
W91-00788

SURVEY OF THE PROTEIN CONTENT IN ESTUARINE WATERS.
Cochin Univ. of Science and Technology (India). School of Marine Sciences.
A. N. Balchand, S. M. Nair, and P. N. K. Nambisan.
Toxicological and Environmental Chemistry TXECBP, Vol. 27, No. 4, p 285-296, 1990. 3 fig, 1 tab, 47 ref.

Descriptors: *Estuaries, *Nutrient concentrations, *Proteins, *Water chemistry, Chlorophyll, Dissolved organic carbon, Nitrates, Nitrogen, Phosphates, Phosphorus, Runoff, Statistical analysis, Ureas.

A survey of the protein content in a tropical estuary and its nearshore regions are reported for two seasons (postmonsoon (November 1987) and monsoon (June 1988)) using a modified dye binding method. The interest in the study of protein content in aquatic waters is generated by the fact that much of the organic fraction of dissolved and particulate matter is proteinaceous. Study of this parameter is related to planktonic nutritional state, metabolic activities based empirically on the ratio of protein to carbohydrate and recognized on the magnitude of its contribution to both detritus and plankton. The content of protein varied from 0.05 to 8.0 microg/L in the fresh and estuarine waters with little variability between surface and bottom values. The enhanced biological production during postmonsoon months causes a higher level of protein in the lower estuary compared to low values in the freshwater, riverine end. Increased terrestrial runoff and discharge of industrial waste mainly from seafood processing units are linked to the higher concentrations of protein in monsoon, more than double the content during postmonsoon. Auxiliary data on chlorophyll, organic nitrate nitrogen, phosphate phosphorus, urea and dissolved organic carbon support the above contentions. Interparametric relationships suggest seasonally varying correlation between protein and chlorophyll, urea and dissolved organic carbon, signifying the role of biological control. (Author's abstract)
W91-00795

RADIOACTIVITY LEVEL OF BLACK SEA MARINE ALGAE BEFORE AND AFTER THE CHERNOBYL ACCIDENT.
Istanbul Univ. (Turkey). Dept. of Pharmaceutical Technology.
For primary bibliographic entry see Field 5B.
W91-00796

DISTRIBUTION AND CORRELATION OF ELEMENTS IN WATERS, SUSPENSIONS, SEDIMENTS, AND MARINE ORGANISMS FROM THE BLACK SEA.
Bulgarian Academy of Sciences, Varna. Inst. of Oceanography.
For primary bibliographic entry see Field 5A.
W91-00797

WATER MASSES AND EUTROPHICATION IN A GREEK ANOXIC MARINE BAY.
National Centre for Marine Research, Athens (Greece).
For primary bibliographic entry see Field 5B.
W91-00798

SPECTRAL IRRADIANCE AND DISTRIBUTION OF PIGMENTS IN A HIGHLY LAYERED MARINE MICROBIAL MAT.
University of Puget Sound, Tacoma, WA. Dept. of Biology.
B. K. Pierson, V. M. Sands, and J. L. Frederick.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2327-2340, August 1990. 10 fig, 4 tab, 23 ref. NSF Grant BSR-8521724.

Descriptors: *Marine bacteria, *Phototropism, *Pigments, *Salt marshes, *Wetlands, Bacterial mats, Chlorophyll, Cyanophyta, Great Sippewissett Salt Marsh, Marine environment, Massachusetts, Spectral irradiance, Sulfur bacteria.

The spectral irradiance from 400 to 1,100 nm was measured with depth in the intertidal sand mats at Great Sippewissett Salt Marsh, Mass. These mats contained at least four distinct layers, composed of cyanobacteria, purple sulfur bacteria containing bacteriochlorophyll a (Bchl a), purple sulfur bacteria containing Bchl b, and green sulfur bacteria. Spectral irradiance was measured directly by layering sections of mat on a cosine receptor. Irradiance was also approximated by using a calibrated fiber-optic tip. With the tip, irradiance measurements could be obtained at depth intervals less than 250 micrometers. The irradiance spectra were correlated quantitatively and qualitatively with the distribution of the diverse chlorophyll pigments in this mat and were compared with spectra recorded in plain sand lacking pigmented phototrophs. The shorter wavelengths (400 to 550 nm) were strongly attenuated in the top 2 mm of the mat. The longer wavelengths (red and near infrared) penetrated to much greater depths, where they were attenuated by Bchl a, b, and c-containing anoxygenic phototrophic bacteria. The specific attenuation bands in the irradiance spectra correlated with the specific in vivo absorption bands of the Bchl-protein complexes in the bacteria. It is concluded that the pigments in the phototrophs had a profound affect on the light environment within the mat. It seems likely that the diverse Bchl-protein complexes found in the anoxygenic phototrophs evolved in dense mat environments as a result of competition for light. (Author's abstract)
W91-00826

VARIABILITY OF BIOGENIC SULFUR FLUX FROM A TEMPERATE SALT MARSH ON SHORT TIME AND SPACE SCALES.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
M. C. Morrison, and M. E. Hines.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1771-1779, July 1990. 7 fig, 1 tab, 35 ref. NASA Grant NAGW-512.

Descriptors: *Biochemistry, *Biogas, *Methane, *Salt marshes, *Spartina, *Sulfur compounds, Biogenic sulfur emissions, Carbonyls, Dimethyl sulfide, Ecosystems, Fluctuations, Sulfides, Vegetation.

Three emission chambers were deployed simultaneously to measure rates of emission of dimethyl sulfide, methane thiol and carbonyl sulfide within or across vegetation zones in a New Hampshire salt marsh. Short term (a few hours) variation in fluxes of all S gases from replicate sites were small within a monospecific stand of either Spartina alterniflora or S. patens. The quantity of emergent biomass and the type of vegetation present were the primary factors regulating the rate of emission. Dimethyl sulfide fluxes from the S. alterniflora soils ranged from 800 to 18000 nmol/sq m/hr compared to emissions of 25-120 nmol/sq m/hr from S. patens. This difference was probably due to the presence of the dimethyl-sulfide precursor dimethylsulfoniopropionate which is an osmoregulator in S. alterniflora but not in S. patens. Methane thiol emissions form S. alterniflora were 20-280 nmol/sq m/hr and they displayed a similar diel trend as dimethyl sulfide, although at mush lower rates, suggesting that methane thiol is produced primarily by leaves. Methane thiol emission form S. patens were 20-70 nmol/sq m/hr. Net uptake of carbonyl sulfide of 25-40 nmol/sq m/hr occurred in stands of S. alterniflora while net efflux of 10-36 nmol/sq m/hr of carbonyl sulfide occurred in stands of S. patens. In general, ranges of emissions of sulfur gases were similar to most other published values. (Author's abstract)
W91-00847

MATHEMATICAL MODELLING OF SEA WATER INTRUSION, NAURU ISLAND.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
F. Ghassemi, A. J. Jakeman, and G. Jacobson.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 269-281, July/September 1990. 7 fig, 4 tab, 18 ref.

Descriptors: *Finite element method, *Groundwater quality, *Model studies, *Nauru Island, *Saline water intrusion, *Water resources development, *Water resources management, Brackish water, Desalination, Geohydrology, Islands, Seawater, Simulation analysis, Water quality management, Water supply.

A two dimensional finite element model for density dependent groundwater flow was calibrated to simulate sea water intrusion in Nauru Island in the Central Pacific Ocean. Nauru Island occupies an area of 22 square km and supports a population of 8500. The island has been mined for its phosphate deposits and current reserves indicate that the mine has about eight years life remaining. The water supply of the island is about one third dependent on imported water which is also used as ballast on the phosphate ships. Imported water will not be available in the future, and a hydrogeological investigation shows that the island is underlain by a fresh water layer, less than 5 m thick. The freshwater layer overlies a thick transition zone of brackish water which in turn overlies sea water. Simulation of several management options shows that it is possible to substitute current importation of fresh water by careful extraction form the groundwater resources of the island. This can be accomplished only by pumping in properly designed skimming wells which prevent the upward movements of the brackish and saline waters. Clearly, other alternatives to overcome the shortfall in water supply such as construction of additional storage capacity to collect the rainfall or desalination of sea water should be considered and the cost-effectiveness of each alternative be carefully investigated. (Author's abstract)
W91-00865

MOTION OF COASTAL GROUNDWATER IN RESPONSE TO THE TIDE.
Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
For primary bibliographic entry see Field 2F.
W91-00884

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

LOGGING EFFECTS ON STREAMFLOW: WATER YIELD AND SUMMER LOW FLOWS AT CASPAR CREEK IN NORTHWESTERN CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
E. T. Keppeler, and R. R. Ziemer.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1669-1679, July 1990. 7 fig, 4 tab, 40 ref.

Descriptors: *Forest management, *Logging, *Low flow, *Streamflow, *Water yield improvement, California, Caspar Creek, Forest watersheds, Selective harvesting, Small watersheds, Streamflow data.

In rain-dominated portions of the Pacific Northwest, annual water yield may be enhanced by the removal of forest vegetation from small upland watersheds. Streamflow data for a 21-yr period were analyzed to determine the effects of selective tractor harvesting of second-growth Douglas fir and redwood at the Caspar Creek watershed on the volume, timing, and duration of low flows and annual water yield in northwestern California. Streamflow was augmented both for the low-flow season and the annual period. Increases were greatest in the year after logging was completed, 1974, and diminished irregularly thereafter. Increases in summer flow volume were detected between 1972 and 1978, although not all of these increases were considered statistically significant. Enhancement of summer flow volume was less persistent than annual flow increases. Selective harvesting of second-growth forest along California's north coast for increasing water yield is not considered promising for two reasons: (1) difficulty of predicting the timing and extent of streamflow increases, and (2) the quality of the supply could be adversely affected by increases in suspended sediment and turbidity. (See also W91-00610) (MacKeen-PTT)
W91-00611

WATER QUALITY AND PAM INTERACTIONS IN REDUCING SURFACE SEALING.
Volcani Inst. of Agricultural Research, Bet-Dagan

(Israel).
For primary bibliographic entry see Field 4D.
W91-00791

3C. Use Of Water Of Impaired Quality

INACTIVATION OF ENTERIC VIRUSES IN CHLORINATED WASTEWATER SPRAYED ON VEGETABLES.
Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5D.
W91-00548

SIMULATING PHYSICAL PROCESSES AND ECONOMIC BEHAVIOR IN SALINE, IRRIGATED AGRICULTURE: MODEL DEVELOPMENT.
Geological Survey, Menlo Park, CA.
L. J. Lefkoff, and S. M. Gorelick.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1359-1369, July 1990. 9 fig, 3 tab, 60 ref.
NSF Grant BCS-8957186.

Descriptors: *Cost analysis, *Groundwater irrigation, *Irrigation design, *Irrigation practices, *Saline water, *Saline-water irrigation, *Water resources management, Agriculture, Aquifer systems, Arkansas Valley, Colorado, Computer models, Crop yield, Mathematical models, Salinity, Surface-groundwater relations, Water resources planning, Water use.

A model of an irrigated, saline stream-aquifer system was constructed to simulate economic, agronomic and hydrologic processes. The model was applied to a section of the Arkansas Valley in southeastern Colorado and was used to examine the effect of crop-mixing strategies on long-term profits. Mixing in excess of crop rotation requirements provides an index of farmers' willingness to exchange some profit for a reduction in the risk of short-term loss. The model contains three components. The economic component simulates water use decisions that maximize annual profit for each farm. The hydrologic component simulates salt transport by employing regression equations that predict changes in groundwater salinity as a function of hydrologic conditions and water use decisions. The agronomic component approximates changes in corn and alfalfa production in response to the depth and salinity of irrigation applications. Results from the model were compared to limited hydrologic and economic data from the site. The regression functions used in the model provided reasonable salinity values for 1982 when compared to observed data. The economic component of the model gave a mean profit of $80/acre, and the actual mean value was $75/acre. (See also W91-00586) (Author's abstract)
W91-00585

BENEFITS OF AN IRRIGATION WATER RENTAL MARKET IN A SALINE STREAM-AQUIFER SYSTEM.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 3F.
W91-00586

RECLAIMED WATER HELPS FIGHT DROUGHT.
R. G. Saunders.
Public Works PUWOAH, Vol. 121, No. 8, p 53-55, 1990. 1 fig, 1 tab.

Descriptors: *California, *Drought, *Potable water, *Reclaimed water, *Water resources management, *Water reuse, Chlorination, Economic aspects, Effluents, Irrigation, Water quality.

In 1989, local public and private water agencies in the Santa Clara Valley, California communities agreed to reduce water use by at least 25 percent from 1987 usage because of the long term drought conditions in the region. Despite the drought, Santa Clara had a new water source, reclaimed water, helping to replace some of the potable water shortage. Reclaimed water was used for construction projects, dust control and soil compaction at the city's landfill, and lands ape irrigation. Santa Clara's reclaimed water source is treated effluent from the San Jose/Santa Clara Water Pollution Control Plant. In 1978, and again in 1980, regional studies identified potential uses for reclaimed water. Although several potential industrial users and irrigation sites were identified, few projects were economically feasible. The high cost of installing and operating a reclaimed water system together with low cost potable water supplies made water reclamation too expensive. In addition, many potential irrigation sites nearest the bay have soils that are least able to accommodate the high salt and total dissolved solids contained in typical effluent. An appropriate reclaimed water application was the new city golf course, built upon imported soil on top of a former landfill. The reclaimed water system was required to deliver a peak flow of 1600 gpm through 13500 ft of pipeline. To meet the demand, the reclaimed water pump station has four Peabody-Flowaway, Inc., vertical turbine pumps, a 10000 gallon hydro-pneumatic tank, and a motor control center. The reclaimed water is such a high quality effluent that no added treatment was considered necessary. However, there is some bacterial regrowth in the channel and in the pipeline, which could be eliminated via an added chlorination system. Another problem with having the pumping station at the outfall channel is the plants and algae growing in this open channel. To limit the plant growth, a post-construction design change added an in-line filter. The reclaimed water rate is set at ninety percent of the retail rate, not including any surcharge, and the economics for new reclaimed water services continue to be favorable. (Brunone-PTT)
W91-00772

GROUNDWATER RECHARGE WITH RECLAIMED WATER IN CALIFORNIA.
Camp, Dresser and McKee, Inc., Clearwater, FL.
For primary bibliographic entry see Field 4B.
W91-00800

PHOTOCHEMICAL DISINFECTION OF EFFLUENTS-PILOT PLANT STUDIES.
Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.
For primary bibliographic entry see Field 5D.
W91-00807

3D. Conservation In Domestic and Municipal Use

WATER SUPPLY FOR MEXICO CITY.
Universidad Autonoma Metropolitana, Mexico City. Unidad Iztapalapa.
H. H. Blasig, and R. A. Juarez.
Aqua AQUAAA, Vol. 39, No. 2, p 79-85, April 1990. 4 fig, 9 tab, 14 ref.

Descriptors: *Mexico City, *Municipal water, *Water conservation, *Water demand, *Water resources management, *Water supply, Human population, Interbasin transfers, Urban planning, Water loss, Water policy, Water reuse, Water shortage.

A severe shortage of potable water is imminent for Mexico City. Continuous population growth is causing an increasing potable-water demand. There are also inadequacies in the water-supply system which result in a chronic potable-water shortage. Proposed solutions to this problem include (a) curtailment of population growth, (b) water reuse, (c) administrative and technical measures to obtain savings in water consumption, (d) a reduction in losses in the distribution system, and (b) better management of the local water resources. An alternative is to import water from other basins, but this would affect other water users and would result in unnecessary expenditure. Only a set of intelligent and well-coordinated political and technical measures, enforced as soon as possible, can assure future water supply for Mexico City and avoid a major shortage that could be the origin of an impending social crisis in the country's capital. (Stoehr-PTT)
W91-00020

EFFECT OF DROUGHT ON URBAN WATER SUPPLIES. I: DROUGHT ANALYSIS.
Resource Consultants, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 6D.
W91-00059

EFFECT OF DROUGHT ON URBAN WATER SUPPLIES. II: WATER-SUPPLY ANALYSIS.
Resource Consultants, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 6D.
W91-00060

RECLAIMED WATER HELPS FIGHT DROUGHT.
For primary bibliographic entry see Field 3C.
W91-00772

3E. Conservation In Industry

COMPETITIVE ASSESSMENT OF THE U.S. WATER RESOURCES INDUSTRY.
International Trade Administration, Washington, DC.
For primary bibliographic entry see Field 6D.
W91-00561

3F. Conservation In Agriculture

WATER AUCTIONS AS AN ALLOCATION MECHANISM IN VICTORIA, AUSTRALIA.
Department of the Interior, Washington, DC. Office of Program Analysis.
For primary bibliographic entry see Field 6C.
W91-00080

EFFECT OF SYSTEM LAYOUT ON SUBSURFACE DRAINAGE COST IN FLAT IRRIGATED LAND.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Center for Drainage Studies.
For primary bibliographic entry see Field 4B.
W91-00081

DYNAMICS OF SIMULATED EFFECTS OF IRRIGATION OVER DRYLAND FARMING IN SASKATCHEWAN.
Saskatchewan Univ., Saskatoon. Dept. of Agricultural Economics.
R. A. Schoney, W. J. Brown, and S. N. Kulshreshtha.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 509-517, June 1990. 2 fig, 5 tab, 6 ref.

Descriptors: *Economic evaluation, *Irrigation efficiency, *Irrigation programs, *Saskatchewan, Agriculture, Canada, Drought, Economic aspects, Farm income, Public policy.

Irrigation development in Saskatchewan was initiated as an instrument to bring forth regional stability through drought proofing and diversification in the agricultural sector. This development has been surrounded by controversy, particularly, questions concerning its economic value to the farmer. A study was conducted to compare irrigation on a farm as a growth alternative to the expansion of dryland farming. Under relatively conservative machine replacement policies, modest family withdrawals, government subsidized irrigation loans, and relatively favorable gross operating margins, irrigation can be a profitable undertaking in the South Saskatchewan River Basin. (Author's abstract)
W91-00091

DESIGN OF SETTLING BASINS.
Indira Gandhi National Open Univ., New Delhi (India).

For primary bibliographic entry see Field 2J.
W91-00097

DRIP IRRIGATION NONLINEAR OPTIMIZATION MODEL.
Concepcion Univ. (Chile). Dept. of Agricultural Engineering.
E. A. Holzapfel, M. A. Marino, and A. Valenzuela.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 479-496, July/August 1990. 2 fig, 7 tab, 15 ref. Research Division of the University of Concepcion at Chillan, Project 202317; Agricultural Research Service Cooperative Agreement 4350-H; Fundacion Andes Project 10463.

Descriptors: *Drip irrigation, *Hydraulic models, *Irrigation engineering, *Model studies, *Nonlinear programming, *Optimization, Agriculture, Computer models, Cost-benefit analysis, Evaluation, Farm income, Irrigation practices, Orchards, Pipes.

Drip irrigation systems were originally introduced for irrigating highly productive crops or orchards in areas where water was scarce and expensive. Drip systems are most profitable when used in areas with hilly topography, poor soils, and/or scarcity of water. In such conditions, the use of drip systems has many advantages over surface irrigation systems. The optimal design of drip irrigation systems can be an important factor to increasing farm profits, and investing money in irrigation most efficiently. A nonlinear optimization model was developed for the design and management of drip irrigation systems. Decision variables are: pipe diameter, pipe length, number of subunits, number of subunits operating simultaneously, irrigation time per set, and emitter discharge. The model is solved using the GAMS-MINOS package. To illustrate the capability of the model, an orchard field of pears was selected. The price effect on the results of the model shows that the cost of the system and its operation are relatively small compared with the benefit obtained. The model shows that the results do not yield the minimum cost of the system when the marginal benefit is greater than the marginal cost. (Fish-PTT)
W91-00168

WATER AND NITROGEN MANAGEMENT IN CENTRAL PLATTE VALLEY OF NEBRASKA.
Nebraska Univ., Clay Center. South Central Research and Extension Center.
R. B. Ferguson, D. E. Eisenhauer, T. L. Bockstadter, D. H. Krull, and G. Buttermore.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 557-565, July/August 1990. 4 fig, 2 tab, 16 ref.

Descriptors: *Groundwater pollution, *Irrigation engineering, *Nebraska, *Nitrates, *Nitrogen, *Nonpoint pollution sources, *Water pollution control, *Water resources management, Corn, Fertilizers, Furrow irrigation, Grain crops, Irrigation practices, Leaching, Path of pollutants, Percolation, Soil water.

Contamination of groundwater by nitrogen leached from fertilizer on irrigated soils is related to the quantity of nitrate-N (NO(-3)-N) present, the leaching potential based on soil texture and the percent depletion of available soil water in the root zone, and the amount of water entering the soil profile. Research and demonstration projects in the Central Platte Valley of Nebraska have shown that NO(-3)-N leaching is influenced by both irrigation and fertilizer-nitrogen (N) management in corn production. Scheduling irrigation according to available soil water depletion can reduce deep percolation to a certain extent. Additional reduction in deep percolation can be achieved by improving the efficiency of water application, particularly on furrow irrigated fields. Testing for NO(-3)-N in irrigation water and soil can provide for substantial reductions in fertilizer N application, if residual levels in the soil are high, or if considerable NO(-3)-N is applied with irrigation water. Grain yields were not appreciably affected by the use of these management practices, while in most cases input costs for fertilizer nitrogen and irrigation water were reduced. (Author's abstract)
W91-00173

CONJUNCTIVE USE FOR IRRIGATION DEVELOPMENT IN ALLUVIAL REGIONS: PROBLEMS, PROSPECTS AND RESEARCH ISSUES.
Bihar Coll. of Engineering, Patna (India). Dept. of Civil Engineeering.
T. Prasad.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 411-422, 2 fig, 7 ref.

Descriptors: *Conjunctive use, *Groundwater irrigation, *India, *Irrigation practices, *Surface-groundwater relations, *Water resources development, Agriculture, Groundwater budget, Irrigation water, Surface water.

Alluvial regions in India, particularly those in the lower Ganga basin, have high agropotential due to good agroclimate, fertile land and ample water resources. Irrigation constitutes an essential requirement for optimal agricultural development, but irrigation exclusively by surface water is not wholly effective or optimally productive on account of the seasonality of flows in the rivers and other ecological factors. As there is ample groundwater of good quality available at relatively low lifts, and a substantial hydrologic interaction constantly going on between the surface water and groundwater regimes, conjunctive use of these two sources is an obvious strategy of irrigation for optimum agricultural development. Several physical and socio-economic issues related to conjunctive irrigation still and unresolved which inhibit adoption and implementation of this strategy in professional practice. Several physical processes related to the interaction of surface water/groundwater regimes in the alluvial plains and their response to conjunctive uses are not quantitatively understood. Also, suitable policies regarding concepts of ownership of surface and groundwater sources, relative economics of the use of water for agriculture from these two sources, administrative and management structure, and energy issues have to be evolved and prescribed for promoting conjunctive irrigation in the alluvial plains. (See also W91-00215) (Lantz-PTT)
W91-00261

TRENDS IN IRRIGATION DEVELOPMENT, AND THEIR IMPLICATIONS FOR HYDROLOGISTS AND WATER RESOURCES ENGINEERS.
G. M. Higgins, P. J. Dieleman, and C. L. Abernethy.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 393-406, 1987. 8 fig, 7 tab, 5 ref.

Descriptors: *Developing countries, *Irrigation, *Irrigation programs, *Water management, Agricultural engineering, Agriculture, Human population, Hydrology, Land use, Population dynamics, Program management, Water potentials.

There are a number of reasons for expecting that we are approaching a period in which irrigated agriculture in developing countries will undergo significant changes. Changes seems likely in the techniques used, the organization and institutions of irrigation, the methods of financing, and perhaps either in the distribution of irrigation. The extent and degree of irrigation around the world are discussed, as well as the rate of new development of irrigation area, the environmental impact of irrigation projects and the need for agricultural production growth to exceed population growth. The population-supporting capacity of land and water requirements of irrigation are analyzed. In the past two decades, a number of technological innovations, such as drip and micro-irrigation and large mechanized water delivery systems, have been developed in industrialized nations. These technologies have not been implemented in many developing nations, and this is an area that should be addressed. There is also a need to improve the management and organization of irrigation projects in developing nations. Africa is an area where all of the above concerns are particularly acute; irrigation data, planning, management, training and research are especially important on this continent. Some possible contributions of hydrology to irrigation are: more measurement of the equity and timeliness of flows within canal distribution networks; better data on droughts and low flow periods; increased attention to quantifying the water resources of smaller streams and non-perennial streams; and, increased data on sediments on rivers. (Hoskin-PTT)
W91-00377

GROUND WATER MANAGEMENT IN THE SOUTH PLATTE BASIN OF COLORADO.
Central Colorado Water Conservancy District, Greeley.
For primary bibliographic entry see Field 4B.
W91-00413

HEURISTIC CLOSED-LOOP CONTROLLER FOR WATER DISTRIBUTION IN COMPLEX IRRIGATION SYSTEMS.
Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung.
H. Hiessl, and E. J. Plate.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1323-1333, July 1990. 7 fig, 2 tab, 41 ref.

Descriptors: *Irrigation design, *Irrigation practices, *Irrigation water, *Water control, Agriculture, Computer models, Crop yield, Saudi Arabia, Simulation analysis, Water conservation, Water distribution, Water resources management, Water resources planning.

The problem of finding an optimal, closed-loop control strategy for irrigation water distribution among crops grown in an irrigation system was investigated. The proposed approach yields a strategy that allows the utilization of prior 'soft' information. The control strategy is then optimized using a mixed simulation-optimization method. The results which are illustrated by a Saudi Arabian case study show that it is possible to improve the annual yields of the crops, both in terms of their expected value as well as in terms of their temporal distribution over the planning horizon. (MacKeen-PTT)
W91-00582

DYNAMIC OPTIMIZATION MODEL FOR IRRIGATION INVESTMENT AND MANAGEMENT UNDER LIMITED DRAINAGE CONDITIONS.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
K. C. Knapp, B. K. Stevens, J. Letey, and J. D. Oster.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1335-1343, July 1990. 2 fig, 4 tab, 15 ref, append.

Descriptors: *Irrigation design, *Irrigation practices, *Irrigation water, *Water control, *Water resources management, *Water table rise, Agriculture, Computer models, Drainage practices, Mathematical models, Unconfined aquifers, Water conservation, Water distribution, Water resources planning.

Irrigation management in a field underlain by a water table aquifer is considered. The water table varies with deep percolation which is in turn a function of the irrigation system and applied water quantities. A drainage system is installed once the water table reaches a maximum height. Optimal irrigation systems and applied water quantities were calculated using dynamic programming. For low confining layer conductivities, deep percolation is progressively reduced through time under optimal management by a combination of improved irrigation systems and reduced water applications. This delays the water table build-up and

postpones drainage costs. Optimal management for a moderately conductive confining layer results in a cyclical policy in which periods of improved irrigation systems and reduced water applications are alternated with periods of traditional irrigation systems and water applications to maintain the water table below the depth requiring drainage system installation. (Author's abstract)
W91-00583

SIMULATING PHYSICAL PROCESSES AND ECONOMIC BEHAVIOR IN SALINE, IRRIGATED AGRICULTURE: MODEL DEVELOPMENT.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 3C.
W91-00585

BENEFITS OF AN IRRIGATION WATER RENTAL MARKET IN A SALINE STREAM-AQUIFER SYSTEM.
Geological Survey, Menlo Park, CA.
L. J. Lefkoff, and S. M. Gorelick.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1371-1381, July 1990. 11 fig, 2 tab, 32 ref. NSF Grant BCS-8957186.

Descriptors: *Cost-benefit analysis, *Economic aspects, *Groundwater irrigation, *Irrigation programs, *Irrigation water, *Management planning, *Saline-water irrigation, *Water management, *Water transfer, Arkansas Valley, Colorado, Computer models, Drought, Economic evaluation, Groundwater, Model studies, Pumping, Salinity, Simulation analysis, Surface water, Surface-groundwater relations, Water control, Water shortage, Water use.

The hydrologic and economic effects of a water market were evaluated for an irrigated, stream-aquifer system in the Arkansas Valley, Colorado. In the hypothetical rental market, surface water is traded annually among farmers, while groundwater is used to augment irrigation supplies. Market simulations account for changes in the value of groundwater and surface water due to salinity differences. Results show that the market increases long-term profit for all participants, reduces the risk of loss due to drought, and decreases average short-term groundwater salinity. The market becomes active during dry years, when farmers without groundwater rights buy surface water from farmers with groundwater rights, who increase pumping to replace sold surface water. Under the rental market the distribution of additional profits partially depends on the pumping costs and higher salinity associated with increased groundwater use. Farmers reduce risk without sacrificing profit, by utilizing higher rates of groundwater pumping to mitigate drought damage. Increased withdrawals may diminish irrigation supplies for downstream users. (See also W91-00585) (Author's abstract)
W91-00586

OPERATION AND MAINTENANCE ACTIVITIES OF AN IRRIGATION SYSTEM IN JAVA (IN JAPANESE).
Y. Matsumoto.
Research Bulletin of the Faculty of Agriculture Gifu University, No. 54, p 171-179, December 1989. 4 fig, 1 tab, 7 ref. English summary.

Descriptors: *Irrigation, *Irrigation design, *Irrigation operation, *Java, Coasts, Drainage, Indonesia.

Effective technical assistance to irrigation projects in Southeast Asia requires sound judgement in actual operation and maintenance activities of the existing irrigation system. In order to obtain information, a progressive irrigation system on Java Island in Indonesia was observed. The Java system has been operated well from the top uptake to the end field and was guaranteed by water user's associations which distribute irrigation water. However, it was found that some districts having difficulty in operating the system had drainage problems in coastal areas and operation and maintenance activities had been clearly separated into two groups: officials managing the main system and farmers managing the tertiary system. Land improvement for more effective operation should be implemented first, and farmers should participate in the maintenance of the main system in order to reduce future costs. (Agostine-PTT)
W91-00767

STATE AGRICULTURAL POLLUTION REGULATION: A QUANTITATIVE ANALYSIS.
Harvard School of Public Health, Boston, MA. Dept. of Health Policy and Management.
For primary bibliographic entry see Field 5G.
W91-00801

RELATIVE PERFORMANCE OF A SOIL MOISTURE ACCOUNTING MODEL IN ESTIMATING RETURN FLOW.
Roorkee Univ. (India). School of Hydrology.
For primary bibliographic entry see Field 2G.
W91-00887

REAL TIME SIMULATION MODEL AS A DECISION SUPPORT SYSTEM FOR SURFACE WATER MANAGEMENT.
Institute for Land and Water Management Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 4A.
W91-00998

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

ESTIMATING STATISTICAL PARAMETERS FOR AN N-SEGMENT DISCRETE HYDROLOGIC DATA SERIES.
Clark Univ., Worcester, MA. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-00074

ERRORS IN ESTIMATED STREAMFLOW PARAMETERS AND STORAGES FOR UNGAUGED CATCHMENTS.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W91-00085

UTILITY APPROACH TO STORMWATER MANAGEMENT.
Jones and Henry Engineers, Inc., Fort Wayne, OH.
H. Wilson.
Public Works PUWOAH, Vol. 121, No. 6, p 82-83, June 1990. 3 tab.

Descriptors: *Flood control, *Storm runoff, *Storm water management, *Urban hydrology, *Utilities, Budgeting, Economic aspects, Financial feasibility, Runoff, Stormwater utility, Urban runoff, Water rates.

Communities with improperly managed stormwater drainage systems experience frequent basement, yard, and street flooding that will continue without a proper stormwater management program. Municipal officials often cite lack of funds as a reason for not addressing the stormwater runoff problem. As a viable funding alternative, communities may which to consider the utility approach. A stormwater utility, like other utilities, provides a service to the public, supported by charging fees to its customers. Each community must tailor a program to its particular situation and political climate. A few general steps should be considered during utility development. It is important to initially document the need for a stormwater utility program and key city personnel must understand the pros and cons of such a system. Once need is established a steering committee should be developed and public participation encouraged. A comprehensive implementation plan that addresses all program activities and phases is essential. Program costs and an estimation of other stormwater revenue needs, such as maintenance costs should be determined. After needs and steps of the projects are prioritized it is time to establish a preliminary budget. From this a rate structure can be created. When the budget and user charges are finalized it will be necessary to draft a local ordinance that explains the need for the stormwater utility and establishes the user charges by land use classification. After everything is in place, an appropriate billing system, either as a separate stormwater bill or as part of the sewer and water billing system, must be established. (Mertz-PTT)
W91-00104

FLOODING CONTROLLED BY BRIDGE RELOCATION.
Edwards and Kelcey, Inc., Minneapolis, MN.
T. E. Wetmore.
Public Works PUWOAH, Vol. 121, No. 6, p 86-87, June 1990. 1 fig.

Descriptors: *Bridge construction, *Flood control, *Flood plain management, *Minnesota, Bridges, Environmental effects, Flood protection, Road construction, Social aspects.

The communities of Mankato, North Mankato, and LeHillier, Minnesota, are located at the confluence of the Minnesota and Blue Earth rivers, at the heart of one of Minnesota's regional economic centers. They have experienced four major floods within two decades. In 1978, work was begun to fulfill the need for bridge location studies. A socio-economic and environmental impact analysis, a draft environmental impact statement, public information program, and feature design memorandums for bridges at three locations were prepared. Flood elevations and drainage outfall elevations greatly restricted flexibility of design, as did meeting existing street, highway, and railroad grades. Traffic signal systems were developed to coordinate with the Mankato business district system. Local accesses were carefully maintained, and provisions for maintaining rail and highway service to a major industry were carefully worked out with the owners. The project included the complete rebuilding of a motor interchange in North Mandato. Critical vertical clearance requirements were met using a post-tensioned concrete slab bridge. A new ramp and arterial street connections in Mankato were designed to maintain the integrity of the central business district. A new gatewell was built for a 102-foot inplace storm drain. With the successful completion of the $100-million flood control project, transportation service has been improved for over 46,000 motorists a day and the new bridges are able to maintain full service even during maximum expected flood. (Mertz-PTT)
W91-00105

RADAR RAINFALL FORECASTING METHOD DESIGNED FOR HYDROLOGICAL PURPOSES.
Ecole Nationale des Ponts et Chaussees, Paris (France).
For primary bibliographic entry see Field 7B.
W91-00156

SINGLE-OUTLET DETENTION-POND ANALYSIS AND DESIGN.
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W91-00171

OPPORTUNITIES FOR RESERVOIR-STORAGE REALLOCATION.
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 6E.
W91-00186

OPTIMIZATION OF FRESHWATER INFLOW TO ESTUARIES.
Wyoming Univ., Laramie. Water Resources Re-

search Inst.
For primary bibliographic entry see Field 2L.
W91-00187

ANNUAL YIELD AND SELECTED HYDROLOGIC DATA FOR THE ARKANSAS RIVER BASIN COMPACT ARKANSAS--OKLAHOMA 1989 WATER YEAR.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-00360

ASSESSING OPTIONS FOR STREAM REGULATION USING HYDROLOGIC SIMULATIONS AND CUMULATIVE IMPACT ANALYSIS: FLATHEAD RIVER BASIN, USA.
Montana Power Co., Butte.
For primary bibliographic entry see Field 2E.
W91-00779

URBAN STORM-INDUCED DISCHARGE IMPACTS.
Environmental Protection Agency, Edison, NJ. Storm and Combined Sewer Technology Branch.
R. Field, and R. Pitt.
Water Environment & Technology WAETEJ, Vol. 2, No. 8, p 64-67, August 1990. 7 ref.

Descriptors: *Path of pollutants, *Storm runoff, *Urban runoff, *Water pollution sources, Aquatic organisms, Biochemical oxygen demand, Dissolved oxygen, Heavy metals, Sediment contamination, Sediments, Storm sewers, Surface water, Toxicity.

Toxic heavy metals, organic pollutants, fecal coliform bacteria and pathogens, high flow rates, and sediment are commonly associated with urban receiving-water problems. The U. S. Environmental Protection Agency's (EPA) Storm and Combined Sewer Research Program has sponsored several long-term research projects that are concerned with urban receiving-water problems. Preliminary toxicity results have found that runoff samples vary widely in their relative toxicities. Urban storm runoff occurs for relatively short periods of time; therefore, toxicant concentration standards developed for continuous exposures are not directly applicable for these short term discharges. Monitored mass loadings show that great quantities of these toxic compounds are being discharged in urban storm runoff. Additional long-term receiving-water studies have found that aquatic organism surveys indicate significant toxicity problems. The effects of storm-induced discharges on aquatic, receiving-water organisms and other beneficial water uses is site-specific. Attempts to identify urban storm runoff problems using available data have not been conclusive because of sampling procedures and the practice of pooling data from various sites. Therefore, it is necessary to carefully design comprehensive, long-term studies to investigate urban storm runoff problems on a site-specific basis. (Korn-PTT)
W91-00803

HYDROLOGY AND MANAGEMENT OF DROUGHT IN THE UNITED STATES.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00991

CHARACTERISTICS OF STREAMFLOW DROUGHT.
Ohio Univ., Athens. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00994

GENERALIZED COMPONENTS OF COMPLEX DECISION SUPPORT SYSTEMS FOR WATER RESOURCES MANAGEMENT IN RIVER BASINS.
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
A. Becker, P. Braun, and S. Kaden.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 365-378, 4 fig, 11 ref.

Descriptors: *Databases, *Decision making, *Forecasting, *Model studies, *River basins, *Water quality, *Water resources management, Algal growth, Computer programs, ERNA model, Eutrophication, Hydrologic models.

During the last years remarkable progress has been achieved in the development of complex decision support systems for river basin water development. Two selected aspects and components of such systems were examined: the structure and components of real-time forecasting and control systems in river basins and the aquatic ecosystem model ERNA. The consideration of systems for real-time analysis, forecasting, and control in river basins concerns in particular the role and function of computerized information centers, the developed database system, and applied software for forecasting of water levels, discharges, and selected water quality parameters. The ecosystem model ERNA describes the growth of different algae groups in dependence on relevant environmental variables (meteorological, physical, chemical, and biological). It is capable of simulating the eutrophication processes in eutrophicated flatland rivers. (See also W91-00961) (Author's abstract)
W91-00997

REAL TIME SIMULATION MODEL AS A DECISION SUPPORT SYSTEM FOR SURFACE WATER MANAGEMENT.
Institute for Land and Water Management Research, Wageningen (Netherlands).
P. J. T. Van Bakel.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 379-386. 3 fig, 6 ref.

Descriptors: *Hydrologic models, *Irrigation water, *Model studies, *Simulation, *Subsurface irrigation, *Surface water, *Water management, Crop yield, Decision making, Economic aspects, Netherlands, Transpiration, Water conservation, Water level.

For the purpose of water conservation and subsurface irrigation in the Netherlands, special water management systems are in operation by water boards. To support the water boards with their day-to-day surface water management, a total soil/surface water simulation model was made more suitable to use on a real time basis. This model contains operational rules for water level manipulation, which were derived from a case study. Simulation with this decision support model of a water board's situation in the dry year of 1986 resulted in a calculated increase in crop transpiration and hence crop production, equivalent with 100-500 Dfl/ha (2 Dfl equals approximately 1 US dollar). Actual application of the model in the wet year of 1987 did not result in an increase in crop transpiration. Working conditions in autumn, however, did improve. Based on the model, surface water levels were lowered about 5 wk earlier than would have been the case in the traditional method of water level manipulation. These results demonstrate that application of a real time simulation model improves surface water management, both in dry and wet years. (See also W91-00961) (Author's abstract)
W91-00998

INTELLIGENT GEOGRAPHIC INFORMATION SYSTEMS (IGIS) AND SURFACE WATER MODELING.
Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Wasserbau und Wasserwirtschaft und Inst. fuer Wasserbau.
U. Arnold, B. Datta, and P. Haenscheid.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 407-416, 3 fig, 16 ref.

Descriptors: *Expert systems, *Geographic information systems, *Hydrologic models, *Model studies, *Simulation, *Surface water, *Water resources management.

Geographic Information Systems (GIS) are emerging as major spatial data handling tools for natural resources inventory and management. For simulation model applications to surface water related problems, a GIS can serve as a powerful, interactive, and graphics oriented data platform and user environment. However, prior to utilizing available data and models, analysis of the problem's information requirements, the data base contents, and the given boundary conditions is necessary to configure models and data in a most effective and economical way. Problem diagnosis and preprocessing steps such as domain discretization, model parameter selection and calibration require problem-, method-, and tool-specific expertise. A conceptual approach is proposed towards the development of an intelligent GIS which incorporates knowledge processing capabilities for the surface water problem domain. Special attention is given to object oriented methodology, interfaces between numeric data and symbolic knowledge representation, and to dealing with uncertainty. (See also W91-00961) (Author's abstract)
W91-01001

4B. Groundwater Management

EFFECT OF SYSTEM LAYOUT ON SUBSURFACE DRAINAGE COST IN FLAT IRRIGATED LAND.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Center for Drainage Studies.
J. Gallichand, S. O. Prasher, R. S. Broughton, J. F. Metzger, and J. S. A. Brichieri-Colombi.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 397-405, June 1990. 6 fig, 5 tab, 16 ref.

Descriptors: *Construction costs, *Cost analysis, *Drainage engineering, *Drainage systems, *Economic aspects, Cropland, Drainage area, Egypt, Irrigation, Rice.

The economic feasibility of large-scale subsurface drainage projects in irrigated land is affected by construction costs. A study was conducted to evaluate the effect of two different types of subsurface drainage system layout on construction costs for a 1000 ha pilot area located in the Nile Delta of Egypt. The two types of layout studied were the conventional layout currently used in Egypt and a modified layout that was developed for reducing water losses from rice fields. When compared to the conventional layout, the modified layout resulted in a reduction of 6.74% in construction costs ($714,464 versus $766,142). This cost reduction is explained by the need for lesser lengths of large diameter collector pipes with the modified layout, which results from the smaller drainage area of subsurface drainage systems (average 23.7 versus 30.8 ha). The cost of subsurface drainage can be minimized by reducing the area drained by each subsurface drainage system. (Author's abstract)
W91-00081

ESTIMATING GROUNDWATER RECHARGE USING A SURFACE WATERSHED MODELLING APPROACH.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W91-00160

ESTIMATING GROUNDWATER RECHARGE USING A SURFACE WATERSHED MODEL: SENSITIVITY ANALYSES.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W91-00161

OPTIMAL PLANNING AND OPERATION OF MULTIAQUIFER SYSTEM.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Earth Sciences.
H. Yazicigil.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 435-454, July/August 1990. 7 fig, 5 tab, 19 ref.

Descriptors: *Aquifer management, *Groundwater management, *Model studies, *Water resources management, Agricultural hydrology, Drawdown, Management planning, Optimization, Pumping, Saudi Arabia, Selective withdrawal, Simulation analysis.

Three groundwater management models were developed to determine the optimal planning and operating policies of a multiaquifer system in eastern Saudi Arabia for an eight-year planning period. The modeled system, which consisted of the Alat, Khobar, and Umm Er Radhuma aquifers, was represented by a three-dimensional simulation model included in linear and quadratic optimization models using response functions. Yearly optimal pumping policies were determined for 52 well fields under three management objectives that maximized agricultural water withdrawals and minimized total drawdowns, and pumping costs subject to constraints related to the system's response equations, demand requirements, drawdown limitations, and discharge bounds. Multiobjective analyses were conducted to develop tradeoff curves relating increased agricultural water production to drawdown, aquifer dewatering, and pumping costs. Modeling results show the agricultural water production could be increased by almost two and a half times without causing dewatering. Optimal pumping schedules differed, depending upon the type of objective function employed. The best option appears to be the one in which extensive water transport is allowed between municipal well fields. (Author's abstract)
W91-00179

GROUND-WATER-MANAGEMENT AREAS IN UNITED STATES.
Illinois State Water Survey Div., Champaign.
J. A. Bowman.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 484-502, July/August 1990. 9 tab, 11 ref, 2 append.

Descriptors: *Groundwater management, *Legal aspects, *Legislation, *State jurisdiction, *Water resources management, Groundwater quality, Irrigation, Regulations, Selective withdrawal.

Laws governing groundwater withdrawals have been adjusted to reflect the desire and need to prevent resource depletion and conflict among users. Courts today are inclined to regard groundwater more as a shared public resource that is subject to management and regulation than as private property with rights of unlimited use. Also, state legislatures are passing comprehensive groundwater management statutes to prevent depletion and conflict and to reduce historic reliance on the courts to settle groundwater disputes. This has been called a 'management doctrine' for groundwater. One example of the management doctrine is the use of groundwater management areas to regulate regional groundwater withdrawals when and where that is necessary. A nationwide survey was conducted to collect information about the nature and distribution of groundwater management area programs around the country. Results show that 27 states allow for formation of special management areas to address some type of groundwater quantity problem; some areas also address groundwater quality problems. One distinction of interest is that while most states place the responsibility of controlling management areas with some central state agency, several states have opted to leave that responsibility with the local groundwater users. The heavily irrigated states of Colorado, Kansas, Nebraska, and Texas stand out in this regard. (Author's abstract)
W91-00182

PRINCIPLES OF A GROUND-WATER STRATEGY.
Greeley-Polhemus Group, Inc., West Chester, PA.
For primary bibliographic entry see Field 6A.
W91-00183

APPROPRIATE METHODOLOGIES FOR DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES IN DEVELOPING COUNTRIES. VOLUME I.
Papers presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. 485p. Edited by C. P. Gupta, Shakeel Ahmed, V. V. S. G. Rao, and M. T. Rajan.

Descriptors: *Developing countries, *Groundwater budget, *Groundwater management, *Workshops, Data acquisition, Geohydrology, Groundwater movement, Groundwater pollution, Path of pollutants, Water resources development.

This International Workshop (IGW-89) was organized to share the experiences and knowledge of experts from developed as well as developing countries. Some of the issues covered include identification of the state-of-the-art techniques for geohydrological parameter estimation, acquisition of data, analysis of flow in the unsaturated zone, studies of contaminant migration and augmentation of groundwater. All these are essential prerequisites for reliable estimation and rational management of this vital resource. Cost-effectiveness of these techniques is especially important for developing countries. (See W91-00216 thru W91-00266) (Lantz-PTT)
W91-00215

APPROPRIATE WELL DESIGN FOR DEVELOPING FRESH WATER AQUIFER IN A MIXED QUALITY AQUIFER SYSTEM.
Central Ground Water Board, Hyderabad (India).
For primary bibliographic entry see Field 8A.
W91-00221

GROUNDWATER RECHARGE ESTIMATION BY TRITIUM TRACER TECHNIQUE IN SATHUPALLY AREA, ANDHRA PRADESH, INDIA.
Osmania Univ., Hyderabad (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00225

MANAGEMENT AND CONSERVATION OF GROUND WATER RESOURCE THROUGH POINT DILUTION TECHNIQUE USING RADIOTRACER - SOME CASE HISTORIES.
K. S. Pandey, and S. K. Sinha.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 143-153, 4 fig, 2 tab, 4 ref.

Descriptors: *Case studies, *Groundwater management, *Groundwater resources, *India, *Radioactive tracers, *Surface-groundwater relations, *Tracers, *Water conservation, Canals, Developing countries, Groundwater recharge, Infiltration, Seepage, Water loss.

Management and conservation of groundwater resources, using cost-effective techniques such as point dilution, has assumed a greater importance in light of the high cost of irrigation. Experiments adopting point dilution techniques using the radiotracer 131-I were conducted along the banks of the Ghaggar branch of the Sirhind Canal (Sangrur district-Punjab), Amloh minor at Haripur (Patiala district-Punjab) and a water-logged area near Barpal (Suratgarh-Rajasthan). The radiotracer technique is more economical with regard to cost and studies duplication when compared to other methods. This radiotracer technique is simple to use in deep canals with turbulence and fast moving water, whereas canals with heavy weed growth create adverse bottom conditions for the technique. The amount of seepage water loss was evaluated by computing the values of infiltration velocity, wetted perimeter, and hydraulic gradient. Seepage losses from irrigation water conveyance and distribution systems are the greatest contributers to groundwater recharge. Lining the components of the system is seen as essential to reduce water loss. (See also W91-00215) (Lantz-PTT)
W91-00229

ROLE OF GROUND WATER IN CONTROLLING ECOLOGY OF AREA: A CASE STUDY OF GHANA BIRD SANCTUARY - DISTRICT BHARATPUR, RAJASTHAN.
For primary bibliographic entry see Field 6G.
W91-00234

BOREHOLE GEOPHYSICAL LOGGING TECHNIQUES FOR DELINEATING FRACTURED ZONES AND CAVITIES IN HARD ROCK AREAS FOR HYDROFRACTURING: A CASE STUDY.
For primary bibliographic entry see Field 2F.
W91-00241

CONJUNCTIVE USE FOR IRRIGATION DEVELOPMENT IN ALLUVIAL REGIONS: PROBLEMS, PROSPECTS AND RESEARCH ISSUES.
Bihar Coll. of Engineering, Patna (India). Dept. of Civil Engineeering.
For primary bibliographic entry see Field 3F.
W91-00261

AQUIFERS OF THE WESTERN MOUNTAIN AREA.
For primary bibliographic entry see Field 2F.
W91-00304

SNAKE RIVER PLAIN REGIONAL AQUIFER SYSTEM STUDY.
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00306

GROUND-WATER FLOW SYSTEMS OF WESTERN UTAH.
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00307

PROBLEMS OF SEA WATER INTRUSION INTO AQUIFERS OF THE COASTAL DINARIC KARST.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00325

SOME METHODS OF HYDROGEOLOGIC EXPLORATION AND WATER REGULATION IN THE DINARIC KARST WITH SPECIAL REFERENCE TO THEIR APPLICATION IN EASTERN HERZEGOVINA.
Karst Water Research Inst., Trebinje (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00327

HYDROGEOLOGICAL FEATURES OF SOME NORTHERN DALMATIA LITTORAL KARST PARTS, LIKA AND CROATIAN LITTORAL.
Institute of Geology, Zagreb (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00329

HYDROGEOLOGIC FEATURES OF SOME KARST PARTS OF SLOVENIA.
Institute for Karst Research, Postojna (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00330

GEOHYDROLOGY AND REGIONAL GROUND-WATER FLOW OF THE COASTAL LOWLANDS AQUIFER SYSTEM IN PARTS OF LOUISIANA, MISSISSIPPI, ALABAMA, AND FLORIDA--A PRELIMINARY ANALYSIS.
Geological Survey, Baton Rouge, LA.
For primary bibliographic entry see Field 2F.
W91-00332

WATER RESOURCES OF THE WHITE EARTH INDIAN RESERVATION, NORTHWESTERN MINNESOTA.
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 5F.
W91-00341

AVAILABILITY AND HISTORICAL DEVELOPMENT OF GROUND-WATER RESOURCES OF LONG ISLAND, NEW YORK--AN INTRODUCTION.
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00345

GROUND WATER RECHARGE AND POLLUTION POTENTIAL OF DRY WELLS IN PIMA COUNTY, ARIZONA.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5B.
W91-00367

WATER WATER EVERYWHERE . . . HAVE YOU LOOKED.
BCI Geonetics, Inc., Laconia, NH.
For primary bibliographic entry see Field 2F.
W91-00412

GROUND WATER MANAGEMENT IN THE SOUTH PLATTE BASIN OF COLORADO.
Central Colorado Water Conservancy District, Greeley.
T. V. Cech.
Water Well Journal WWJOA9, Vol. 44, No. 6, p 52-54, June 1990.

Descriptors: *Colorado, *Groundwater irrigation, *Groundwater management, *Groundwater recharge, *Legislation, Artificial recharge, Groundwater depletion, Platte River Basin, Water Rights Determination Act, Water management.

The Water Rights Determination Act of 1969 has resulted in improved management of scarce water resources in the South Platte River Basin. This law brought irrigators who were pumping from the alluvial aquifer of a stream within the priority system of surface users. To meet the requirements of this law, which was amended in 1975 to apply to only underground water, junior diverters using tributary wells are required to replace the resulting depletions to the river so that no injury occurs to senior water rights. This is generally achieved by purchasing replacement water to be used by senior diverters, or through groundwater recharge. Of these two practices, recharge has proven to be an economical method for groundwater users to augment their irrigation flows. Approximately 50 recharge projects are presently located in the basin and are responsible for artificially recharging 384,000 acre-feet of groundwater. This particular example of groundwater management in the South Platte Basin shows that legislation sensitive to the interrelationship of surface water and alluvial groundwater can encourage the development of groundwater projects, that recharge is an economical way to meet some of the augmentation requirements of 1969 act, and that significant amounts of water can be recharged in northeastern Colorado as long as adequate amounts of water are available during spring and winter months. (Fleishman-PTT)
W91-00413

DYNAMIC OPTIMIZATION MODEL FOR IRRIGATION INVESTMENT AND MANAGEMENT UNDER LIMITED DRAINAGE CONDITIONS.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3F.
W91-00583

CAPILLARITY CORRECTION FOR FREE SURFACE FLOW REVISITED.
Cornell Univ., Ithaca, NY.
J. Y. Parlange, W. Brutsaert, J. P. Fink, and A. I. El-Kadi.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1691-1692, July 1990. 2 ref.

Descriptors: *Capillarity, *Drawdown, *Groundwater movement, *Mathematical analysis, *Unconfined aquifers, *Water table decline, Diffusion equation, Flow models.

The usual treatment of the initial response of the water table to a sudden drawdown involves a discontinuity at the outflow end of the aquifer. In the description of this problem by means of the diffusion equation of Boussinesq, this discontinuity is damped rapidly and presents no special difficulties. However, when a capillary correction, or similar source term, is applied to this equation, the additional term may exhibit singular behavior. A procedure is presented to deal with this behavior by allowing a discontinuous part for $t < o$. The resulting solution is quite acceptable physically in the case of sudden drawdown. (Author's abstract)
W91-00614

GROUNDWATER RECHARGE WITH RECLAIMED WATER IN CALIFORNIA.
Camp, Dresser and McKee, Inc., Clearwater, FL.
J. Crook, T. Asano, and M. Nellor.
Water Environment & Technology WAETEJ, Vol. 2, No. 8, p 42-49, August 1990. 4 tab, 4 ref.

Descriptors: *Artificial recharge, *California, *Groundwater, *Groundwater management, *Groundwater recharge, *Reclaimed water, *Water reuse, Groundwater depletion, Groundwater potential, Groundwater quality, Groundwater resources, Injection wells, Land disposal, Permits, Regulations.

Groundwater recharge with reclaimed water represents a large potential use of reclaimed water in California; however, there are few planned recharge projects in the state, partly because of economic considerations and continuing health concerns. This situation, coupled with the knowledge that unplanned or incidental recharge with wastewater is widespread and relatively uncontrolled, suggested that it was essential to undertake a comprehensive review of existing regulations and establish statewide policies and guidelines for planning and implementing new projects for groundwater recharge. Recharging groundwater with reclaimed water has several purposes: to prevent saltwater intrusion into fresh water aquifers, to store the reclaimed water for future use, to control or prevent ground subsidence, and to augment nonpotable or potable groundwater aquifers. Proposed state groundwater recharge guidelines include principles, permitting procedures, and criteria for groundwater recharge. The criteria for surface spreading and injection of reclaimed water will address treatment processes, treatment reliability, water quality, monitoring, dilution, time underground, distance to withdrawal, and operational procedures. It is anticipated that criteria for groundwater recharge will be somewhat flexible and take into consideration site-specific conditions such as percolation rate and depth to groundwater. (Korn-PTT)
W91-00800

WATER BANKING THROUGH ARTIFICIAL RECHARGE, LAS VEGAS VALLEY, CLARK COUNTY, NEVADA.
Las Vegas Valley Water District, NV.
K. Brothers, and T. Katzer.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 77-103, July 1990. 17 fig, 8 tab, 15 ref.

Descriptors: *Artificial recharge, *Groundwater availability, *Groundwater management, *Groundwater recharge, *Nevada, *Water resources management, Aquifer characteristics, Calcite, Colorado River, Groundwater chemistry, Groundwater quality, Model studies, Production wells, Pumpage, Water demand.

Artificially recharging the Las Vegas Valley groundwater system is one water resource management option available to the Las Vegas Valley Water District (District) to help meet increasing summer peak water demands. At the present time (1988) the water supply for Las Vegas Valley is made up of ca. 75% Colorado River water and ca. 25% groundwater, which is used primarily in the summer to meet peak demands. The District is investigating the feasibility of increasing the importation of treated Colorado River water into the valley during winter months, banking the water by artificially recharging the groundwater system, and subsequently withdrawing this water to meet summer peak demands and future needs. There were two major concerns regarding the feasibility of artificially recharging treated Colorado River water by deep aquifer injection. The first was the potential for calcite precipitation resulting from native groundwater and aquifer sediments mixing with treated Colorado River water which could reduce the aquifer permeability. The second was the long-term effects on well performance and production longevity by injecting through production wells. Although previous laboratory studies predicted that calcite precipitation would occur, a small-scale artificial recharge pilot study, conducted by the District in 1987, showed insignificant calcite precipitation. A larger scale demonstration project, initiated in February 1988, injected a total of 1153 acre-feet of treated Colorado River water into the principal groundwater system through two existing production wells. Injection was completed in late April and recovery of the native groundwater and Colorado River water mixture continued throughout the summer and fall. Recharge was accomplished by injection through the existing pump columns with minimal retrofitting of the existing wells and no detrimental effects to the pumps or well production rates have been determined. Water quality analyses and geochemical modeling indicate very little, if any, calcite precipitated during recharge and recovery. (Author's abstract)
W91-00880

4C. Effects On Water Of Man's Non-Water Activities

INPUT AND DEPLETION OF WOODY DEBRIS IN ALASKA STREAMS AND IMPLICATIONS FOR STREAMSIDE MANAGEMENT.
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
M. L. Murphy, and K. V. Koski.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 4, p 427-436, Fall 1989. 7 fig, 8 tab, 21 ref.

Descriptors: *Forest watersheds, *Logging, *Streams, *Water quality, *Watershed management, *Woody debris, Alaska, Aquatic habitats, Detritus.

Natural rates of input and depletion of large woody debris (LWD) in southeast Alaska streams were studied to provide a basis for managing streamside zones to maintain LWD for fish habitat after timber harvest. Debris was inventoried in a variety of stream types in undisturbed old-growth forest; 252 pieces of LWD were dated from the age of trees growing on them. Longevity of LWD was directly related to bole diameter: small LWD (10-30 cm diameter) was less than 110 years old, whereas large LWD (>60 cm diameter) was up to 226 years old. Assuming equilibrium between input and depletion of LWD in streams in old-growth forests and exponential decay of LWD, input and depletion rates were calculated from mean age of LWD. Input and depletion rates were inversely

proportional to LWD diameter and ranged from 1%/yr for large LWD in all stream types to 3%/yr for small LWD in large, high-energy, bedrock-controlled streams. A model of changes in LWD after timber harvest (which accounted for depletion of LWD and input from second-growth forest) indicated that 90 years after clear-cut logging without a stream-side buffer strip, LWD would be reduced by 70% and recovery to prelogging levels would take more than 250 years. Because nearly all LWD is derived from within 30 m of the stream, the use of a 30-m wide, unlogged buffer strip along both sides of the stream during timber harvest should maintain LWD. (Author's abstract)
W91-00011

EVALUATION OF TROUT PASSAGE THROUGH SIX HIGHWAY CULVERTS IN MONTANA.
Montana Cooperative Fishery Research Unit, Bozeman.
For primary bibliographic entry see Field 8I.
W91-00012

SALMON OF THE RIVER SIMOJOKI: RESEARCH AND MANAGEMENT (SIMOJOEN LOHI TUTKIMUKSEN JA HOIDON KOHTEENA).
Finnish Game and Fisheries Research Inst., Helsinki.
For primary bibliographic entry see Field 8I.
W91-00016

POTENTIAL COASTAL IMPACTS OF CONTEMPORARY CHANGING CLIMATE ON SOUTH ASIAN SEAS STATES.
Woods Hole Oceanographic Institution, MA. Coastal Research Center.
F. J. Gable, and D. G. Aubrey.
Environmental Management EMNGDC, Vol. 14, No. 1, p 33-46, January/February 1990. 4 fig, 96 ref.

Descriptors: *Asia, *Climatic changes, *Coasts, *Developing countries, *Future planning, *Global warming, *Sea level, Environmental effects, Marine climates, Ocean circulation, Precipitation, Research priorities, Storms.

The threat of man-induced global change on the nations of the South Asian seas region varies from place to place because of differences in exposure to monsoons and storms, differences in local tectonics and subsidence, and variations in air and sea climates. Because several nations are involved, some having subsistence budgets, and given the cost of deriving independently a comprehensive response to global change, the similarities and differences between national settings must be identified soon. These comparisons will form the basis for local response strategies; the similarities provide a basis for responses similar to that of other nations and the differences provide for local adaptation. That climate change on the South Asian coastal region will have an impact is certain; its economics, environment, and coastal land uses are dominated to a certain extent by this marine influence. The extent of these impacts, however, is uncertain. Accompanying global change will be changes in sea level, differences in storm climate, and altered precipitation patterns; science cannot define today what pattern these changes will take. Because global change is inevitable, although its magnitude, timing, and geographic distribution are unknown, the South Asian seas region should begin the appropriate research and planning studies to set forth a reasoned response to global change, for implementation when scientific evidence for global change is more quantitative. (Author's abstract)
W91-00027

ALGORITHM FOR ROUTING UNSTEADY FLOWS IN URBAN DRAINAGE NETWORKS.
Gutteridge, Haskins and Davey Pty Ltd., Sydney (Australia).
J. E. Ball.
Journal of Hydraulic Research JHYRAF, Vol. 23, No. 4, p 327-341, 1985. fig 9, 1 tab, 16 ref.

Descriptors: *Drainage patterns, *Hydraulics, *Model studies, *Routing, *Unsteady flow, *Urban drainage, *Urban hydrology, Algorithms, Channel flow, Finite difference methods, Hydrographs, Mathematical studies, St Venant equation.

The routing of hydrographs through a network is an important aspect of the design and analysis of urban drainage networks due to the flow of urban drainage networks being typically unsteady. The use of numerical solution of the Saint Venant equations to determine the propagation of unsteady flows through pipes has been validated by many researchers during the previous two decades. Among the many numerical techniques which have been developed for the analysis of unsteady flows in open channels is the four-point implicit finite difference scheme, commonly referred to as the Amein scheme. Use of this scheme requires the solution of the equation: C x delta v = -R, where C is a large sparse n x n matrix and delta v and R are n x 1 column vectors. The proposed algorithm uses the properties of the drainage network to develop an efficient algorithm for the solution of C x delta v = -R. This algorithm is based upon partitioning and decomposing the coefficient matrix C. As an additional advantage, the proposed solution algorithm enables the determination of the water surface level within a manhole, and the possibility of surcharge at a manhole. A sample urban drainage network is analyzed showing the use of the proposed solution algorithm. (Author's abstract)
W91-00031

STREAM-CHANNEL INCISION FOLLOWING DRAINAGE-BASIN URBANIZATION.
King County Basin Planning, Seattle, WA.
D. B. Booth.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 407-417, June 1990. 9 fig, 43 ref.

Descriptors: *Channel erosion, *Channel morphology, *Geomorphology, *Model studies, *Urban drainage, *Urban runoff, *Urbanization, Bank erosion, Channel flow, Erosion, Flood discharge, Rehabilitation, Runoff, Sediment transport, Storm runoff, Urban planning, Washington.

Urbanization of a drainage basin results in pervasive hydrologic changes that in turn initiate long-term changes in stream channels. Increases in peak discharges and in durations of high flows result in either quasi-equilibrium channel expansion, where cross-section area increases in near-proportion to the discharge increase, or catastrophic channel incision, where changes occur far out of proportion to the discharge increases that initiated them. Field data and hydrologic modeling of rapidly urbanizing basins in King County, Washington, defined conditions of flow, topography, geology, and channel roughness that identify streams susceptible to incision. Channel slope and geologic material are particularly critical; thus simple map overlays, nearly irrespective of contributing drainage area, provide a valuable planning tool for identification of susceptible terrain. Where such conditions exist, basal shear stress provides a quantifiable parameter for predicting likely problems, although knick-points are typical in such settings and confound simple calculation of sediment-transport rates. Where urbanization proceeds in such areas, effective mitigation of the incision hazards requires a degree of stormwater control far in excess of standards typically applied to present development activity. (Author's abstract)
W91-00082

STORMFLOW AND SEDIMENT LOSS FROM INTENSIVELY MANAGED FOREST WATERSHEDS IN EAST TEXAS.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
W. H. Blackburn, R. W. Knight, J. C. Wood, and H. A. Pearson.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 465-477, June 1990. 4 fig, 5 tab, 25 ref.

Descriptors: *Clear-cutting, *Flood peak, *Forest management, *Forest watersheds, *Rainfall-runoff relationships, *Sediment discharge, *Soil erosion, *Streamflow, Conservation, Grazing, Livestock, Texas.

Five small (4 ha) forested watersheds in East Texas were instrumented in December 1980 to determine the effect of forest harvesting, mechanical site preparation, and livestock grazing on stormflow, peak discharge rate, and sediment loss. After three pretreatment years, four of the watersheds were treated as follows: (1) clearcutting followed by roller chopping; (2) clearcutting following by shearing and windrowing; (3) clearcutting following by shearing, windrowing, and continuous grazing; and (4) clearcutting followed by shearing, windrowing, and rotational grazing. Clearcut harvesting and all site preparation treatments significantly increased stormflow, peak discharge, and sediment losses over the undisturbed condition. Roller chopping and shearing/windrowing had little impact on sediment loss from these watersheds and appears to be a sound forest conservation practice for gently sloping watersheds (< 8%). As applied, livestock grazing had minimal impact on stormflow and peak discharge. The moderately stocked continuously grazed treatment had little impact on sediment loss, but the high stocking density of the rotational grazing treatment increased sediment losses over the undisturbed condition. Sediment losses from these intensively managed forest watersheds, even though significantly greater than from undisturbed conditions, were within the range of sediment losses from undisturbed watersheds in the Southeast, below the range of losses from mechanically prepared watersheds elsewhere, and well below potential losses from pasture and cropland. (Author's abstract)
W91-00087

FISHES OF BULLITT COUNTY, KENTUCKY.
Clemson Univ., SC. Dept. of Biological Sciences.
D. J. Durbin, and W. D. Pearson.
Transactions of the Kentucky Academy of Science TKASAT, Vol. 51, No. 12, p 6-13, March 1990. 1 fig, 3 tab, 25 ref.

Descriptors: *Fish populations, *Kentucky, *Land use, *Stream fisheries, Environmental effects, Population dynamics, Species composition, Species diversity, Surveys.

Bullitt County, Kentucky has undergone substantial changes in human population and land use over the past few decades. The 1980 census reported and increases of 4.5 times the number of people living in the area since the 1940 census. As the human population rose dramatically between 1960 and 1980, some the county's farmland was converted to residential uses; in addition, the number of industrial plants rose from 2 in 1950 to about 20 in 1983. To study the impacts of land use changes, 60 collections of fishes were made from 35 sites on 24 streams in Bullitt County between June and November, 1986. A total of 7,707 specimens, representing 58 species and 14 families, was collected. From these samples, as well as records from several previous surveys, a list for the county was compiled containing 78 species. The 1986 survey was then compared to a similar, but smaller, study made in 1950 to determine whether changes in human activities and land use in the interim had affected fish populations. No overall effect was indicated, but some streams did show signs of degradation as a result of dredging, channelization, pollution, removal of riparian growth and highway construction. One species, Lampetra aepyptera (brook lamprey), may have been extirpated since 1950. (Mertz-PTT)
W91-00108

POSTTREATMENT EFFECTS OF FOREST FERTILIZATION ON THE PREDOMINANT BENTHIC COMMUNITY OF A HEADWATER STREAM IN EASTERN KENTUCKY.
Southern Illinois Univ., Carbondale. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-00109

SIMULATION OF LAND USE CHANGES AND IMPACTS ON THE WATER BALANCE: A CASE STUDY FOR BELGIUM.
Institut Royal Meteorologique de Belgique, Brussels.
F. Bultot, G. L. Dupriez, and D. Gellens.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 327-348, May 1990. 13 fig, 24 ref. Commission of the European Communities Grant CLI-104B(RS).

Descriptors: *Belgium, *Hydrologic models, *Land management, *Land use, *Model studies, *Water resources management, *Watershed management, Coniferous forests, Evapotranspiration, Floods, Forest hydrology, Forest watersheds, Pastures, Stream discharge, Streamflow, Vegetation effects.

Those responsible for land management policies need to know to what extent land surface management can be beneficial or damaging to water resources. The impacts of assumed land use changes in the Houille catchment in Belgium have been simulated by means of a conceptual hydrological model, developed at the Royal Meteorological Institute of Belgium. The largest difference in impacts appears between basin-wide coverage by coniferous forests and pastures. The mean annual effective evapotranspiration is a maximum for 100% coniferous forests (552 mm/year) and a minimum for pastures (477 mm/year), while the mean annual streamflow is a minimum for coniferous forests (556 mm/year) and a maximum for pastures (631 mm/year). As compared with the pastures cover, the coniferous forests cover also demonstrates more frequent low-flow days (+14) and fewer flood days (-10); the discharges associated with extreme flood and low-flow conditions are however almost unaffected. Intermediate results are found for the other vegetation types. The assessment of the impact of limited or complex changes of vegetation may be estimated by a simple proportionality relation using the reference values provided by consideration of extreme hypothetical situations. The enlargement of impervious areas clearly modifies the streamflow regime in the basin by inducing more floods as well as longer low-flow stages. (Author's abstract)
W91-00162

SEDIMENT AND THE ENVIRONMENT.
For primary bibliographic entry see Field 2J.
W91-00280

GEOMORPHIC DESIGN AND MANAGEMENT OF DISTURBED LANDS.
Denver Univ., CO. Dept. of Geology and Geography.
T. J. Toy, and R. F. Hadley.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 145-153, 1 fig, 1 tab, 25 ref.

Descriptors: *Design criteria, *Environmental impact, *Erosion control, *Geomorphology, *Land management, *Land reclamation, *Land use, *Slopes, Channels, Drainage basins, Environmental control, Land resources, Landscaping, Project planning.

Human activities result in a wide variety of land disturbances. The contribution of geomorphology in the design and management of disturbed lands is discussed. Regardless of the type of disturbance, it is proposed that each type can be evaluated in terms of three factors: (1) areal extent, (2) intensity, and (3) duration. The goal in design of a landscape for a disturbed area is to mitigate environmental impacts and re-establish dynamic equilibrium within the geomorphic system. The design of the landscape involves three phases: (1) analysis of existing environmental conditions, (2) formulation of a reclamation program, and (3) program implementation. It is in the formulation of the reclamation program that the fundamental principles of geomorphology find direct application. Climate, geologic structure and lithology, and relief are regarded as the variables most influential in determining the morphology of drainage basins. There is a tradeoff in the design of hillslopes, such that length increases, base increases, and height decreases as gradient decreases for a given volume of material graded. The design of channels for disturbed lands should rest upon the expected hydrologic properties of the reclaimed surface rather than the properties of the natural, predisturbance surface. Post-reclamation management includes site monitoring, remedial actions to repair site deterioration, and decisions to minimize future deterioration. (See also W91-00280) (MacKeen-PTT)
W91-00296

LONG AND SHORT-TERM EPISODIC STORAGE AND REMOVAL OF SEDIMENT IN WATERSHEDS OF SOUTHWESTERN WISCONSIN AND NORTHWESTERN ILLINOIS.
Wisconsin Univ.-Madison. Dept. of Geography.
For primary bibliographic entry see Field 2J.
W91-00297

HILLSLOPE AND CHANNEL SEDIMENT DELIVERY AND IMPACTS OF SOIL EROSION ON WATER RESOURCES.
East Carolina Univ., Greenville, NC. Dept. of Geography and Planning.
For primary bibliographic entry see Field 2J.
W91-00300

PHYSICAL HABITAT SIMULATION AND SEDIMENTATION.
National Ecology Center, Fort Collins, CO.
R. T. Milhous.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 211-218, 2 fig, 1 tab, 18 ref.

Descriptors: *Channel flow, *Flow control, *Instream flow, *Model studies, *Sedimentation, *Simulation analysis, Channel maintenance, Channel morphology, Channel stability, Flushing flow, Habitats, Mathematical models, Sedimentation rates, Stream banks, Streamflow, Watershed management.

Stream channels provide habitat for aquatic species and for animals that use the banks of the stream. Two sedimentation factors are important for maintenance of desirable habitat conditions: (1) maintain desirable channel shape, and (2) maintain desirable substrate by flushing fines through the system. Flushing flow methodology is reviewed, with the conclusion that current techniques are not sufficiently developed for application of any specific analytical channel maintenance methodology to instream flow management, but are closer to providing a quantitative flushing flow methodology. Approaches to selecting a channel maintenance flow based on the simple hydraulic geometry relation will fail if there is any significant change in either sediment load or streamflow. The more complex approaches based on width changes give uncertain results and should be investigated further. Flushing flows can be determined based on considerations of physical habitats and physical processes. (See also W91-00280) (MacKeen-PTT)
W91-00303

EFFECTS OF SUBURBANIZATION UPON SNOWMELT RUNOFF.
Trent Univ., Peterborough (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-00408

HYDROLOGIC AND CHEMICAL-QUALITY DATA FROM FOUR RURAL BASINS IN GUILFORD COUNTY, NORTH CAROLINA, 1985-88.
Geological Survey, Raleigh, NC.
For primary bibliographic entry see Field 5B.
W91-00433

HYDROLOGIC AND WATER-QUALITY DATA FOR STREAMS AND IMPOUNDMENTS IN THE COTEAU DES PRAIRIES--UPPER MINNESOTA RIVER BASIN, 1979-84.
Geological Survey, St. Paul, MN.
For primary bibliographic entry see Field 2E.
W91-00434

HYDROLOGICAL EFFECTS OF CATCHMENT CHARACTERISTICS AND LAND USE CHANGES DETERMINED BY SATELLITE IMAGERY AND GIS.
Ruhr Univ., Bochum (Germany, F.R.). Inst. for Hydrology, Water Resources and Environmental Engineering.
For primary bibliographic entry see Field 2A.
W91-00472

LOGGING EFFECTS ON STREAMFLOW: STORM RUNOFF AT CASPAR CREEK IN NORTHWESTERN CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
K. A. Wright, K. H. Sendek, R. M. Rice, and R. B. Thomas.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1657-1667, July 1990. 9 fig, 4 tab, 36 ref.

Descriptors: *Environmental effects, *Land use, *Logging, *Rainfall-runoff relationships, *Road construction, *Storm runoff, *Streamflow, California, Caspar Creek, Flow profiles, Forest watersheds, Hydrographs, Infiltration, Storage seepage.

The effects of road building and tractor harvesting on storm runoff were assessed for a small (424 ha) coastal watershed on Caspar Creek in northern California. Road building alone did not significantly affect the storm runoff. After road building and logging, lag time was decreased approximately 1.5 hr, and the very small storm volumes (less than 1209 cu m) and storm peaks (less than 566 L/s) were increased by about 132% and 111%, respectively. Storm volumes and peaks of large storms (occurring less frequently than eight times a year) were not significantly increased by either roads or logging, even though more than 15% of the watershed was compacted in roads, skid trails, and landings. Although a decrease in lag time showed that the average storm hydrograph was shifted forward in time, only the small storm hydrographs were changed in shape. It is speculated that the rate of delivery of water to the stream channel during large channel-forming flows was governed by infiltration and subsurface flow rates on the 85% of the watershed that was unaffected by roads, landings, or skid trails. It is concluded that, in a rain-dominated hydrologic environment, logging and forest road construction (as carried out in this study) are not likely to change the flow regime of a stream adversely. (See also W91-00611) (Author's abstract)
W91-00610

LOGGING EFFECTS ON STREAMFLOW: WATER YIELD AND SUMMER LOW FLOWS AT CASPAR CREEK IN NORTHWESTERN CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
For primary bibliographic entry see Field 3B.
W91-00611

PATTERNS OF FISH SPAWNING IN HUDSON RIVER TRIBUTARIES: RESPONSE TO AN URBAN GRADIENT.
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
For primary bibliographic entry see Field 8I.
W91-00617

PILOT STUDIES FOR DESIGNS OF SURVEYS OF HUMAN DISTURBANCE OF INTERTIDAL HABITATS IN NEW SOUTH WALES.
Sydney Univ. (Australia). Inst. of Marine Ecology.
A. J. Underwood, and S. J. Kennelly.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 41, No. 1, p 165-173, 1990. 3 tab, 28 ref.

Descriptors: *Australia, *Ecosystems, *Environmental impact, *Experimental design, *Human population, *Littoral environment, *New South Wales, *Recreational effects, *Surveys, Recreation facilities, Spatial distribution, Variability, Weather.

Data are presented from pilot studies as the first step in the design of large-scale surveys of the effects of human recreational activities on intertidal habitats in New South Wales. People visiting the seashore were counted and interviewed. Numbers of organisms removed for food or bait were determined, as were the numbers of fisherman and scavengers frequenting the shore. Data from pilot studies using these methods assessed the various effects of human recreation during school terms or holidays, on weekdays or weekends and on sunny or overcast days. Pilot sampling at different locations provided estimates of the variability from place to place within 30 km. Sampling was in a fully orthogonal design which allowed tests of various factors and their interactions. More people affected the shore during school holidays than during term-time, but there were no differences between weekends and weekdays. There were significant effects due to weather, with more potential impact occurring on sunny than on overcast days. There were also substantial differences in effects at different places. Other potential sources which should be considered in designing surveys of the effects of human recreation include variability due to time of day, the state of the tide, prevailing weather and various spatial and temporal scales. Such pilot sampling enables the efficient design of the large-scale, long-term surveys that are a necessary prerequisite to determining the magnitude and effects of human disturbances and their eventual management. (Author's abstract)
W91-00685

LEAD POISONING IN MAGPIE GEESE ANSERANUS SEMIPALMATA FROM INGESTED LEAD PELLET AT BOOL LAGOON GAME RESERVE (SOUTH AUSTRALIA).
Australian National Parks and Wildlife Service, Berri.
For primary bibliographic entry see Field 5C.
W91-00687

SEASONAL, HYDROLOGICAL, AND LAND MANAGEMENT FACTORS CONTROLLING DISSOLVED ORGANIC CARBON CONCENTRATIONS IN THE LOCH FLEET CATCHMENTS, SOUTHWEST SCOTLAND.
Stirling Univ. (Scotland). Dept. of Environmental Science.
For primary bibliographic entry see Field 2H.
W91-00862

EVALUATION AND PREDICTION OF POSSIBLE MAN-INDUCED CHANGES IN THE HYDROLOGICAL CYCLE.
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
L. S. Kuchment.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 53-61, 3 fig, 7 ref.

Descriptors: *Climates, *Environmental effects, *Global warming, *Greenhouse effect, *Hydrologic cycle, *Land use, *Model studies, *Transpiration, Atmospheric carbon dioxide, Carbon dioxide, Catchment areas, Deforestation, Hydrologic models, Land development, Physical models, Reforestation, Rivers, Runoff, Watersheds.

Some man-induced changes in the hydrological cycle, particularly in river runoff, occur gradually over a long period of time and manifest themselves differently under various hydrometeorological conditions. This causes considerable difficulties in their detection on the basis of historic data analysis. Physically-based models of the hydrological cycle, taking into account man-induced changes in catchment characteristics, were used to identify man-induced alterations of water balance components and to predict their future changes, resulting from human activity and climate variability. Estimation of possible runoff changes resulting from predicted variations in temperature and precipitation, as well as calculations of transpiration dynamics caused by the changes in atmospheric carbon dioxide content were obtained. Numerical experiments provide an estimation of the impact of land ploughing, afforestation/deforestation, groundwater development and other types of human activity on watershed parameters. Physically based models offer the possibility of predicting changes in water balance components for planning land-use in the river basin and for runoff control on the watershed. (See also W91-00961) (Author's abstract)
W91-00967

USE OF KINEMATIC WAVE METHOD TO ASSESS EFFECTS OF URBAN DEVELOPMENT ON FLOOD PEAK CHANGES.
Nanyang Technological Inst., Singapore. School of Civil and Structural Engineering.
T. S. W. Wong, and C. N. Chen.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. p 93-102. 5 fig, 1 tab, 13 ref.

Descriptors: *Catchment areas, *Flood peak, *Kinematic wave theory, *Mathematical models, *Model studies, *Urban drainage, *Urban hydrology, *Urbanization, Soil water infiltration, Storm runoff, Storm sewers, Storm water.

Kinematic wave method was used to assess the effects of urban development on flood peak changes for an idealized overland catchment and for a range of rectangular drainage basins comprising two identical overland catchments and a drainage channel. The assessment on the overland catchment shows that the change in surface roughness as a result of urbanization causes the greatest increase in flood peak as compared to the changes in soil infiltration and depression storage. The method was applied to a range of idealized rectangular drainage basins of constant area of 1 sq km. For the drainage basin, the degree of urbanization is expressed in terms of the percentage of area made impervious and the percentage of area sewered. The effect of urbanization on the change of flood peaks is expressed in isopleth lines, which are lines of equal ratio of flood peak after and before urbanization. The basin shape has a significant impact on the isopleth line pattern. (See also W91-00961) (Author's abstract)
W91-00971

4D. Watershed Protection

SOIL EROSION IN THE YELLOW RIVER BASIN AND ITS IMPACTS ON RESERVOIR SEDIMENTATION AND THE LOWER YELLOW RIVER.
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China). Dept. of Sedimentation Engineering.
For primary bibliographic entry see Field 2J.
W91-00294

WATER QUALITY AND PAM INTERACTIONS IN REDUCING SURFACE SEALING.
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
I. Shainberg, D. N. Warrington, and P. Rengsamy.
Soil Science SOSCAK, Vol. 149, No. 5, p 301-307, May 1990. 3 fig, 2 tab, 15 ref.

Descriptors: *Erosion, *Erosion control, *Infiltration, *Rainstorms, *Runoff, *Soil chemistry, Aggregates, Bonding, Electrolytes, Polyacrylamides, Soil types.

Seals formed at the soil surface during rainstorms reduce penetration and cause runoff and erosion. Surface application of an anionic polyacrylamide (PAM) was tested at rates of 10, 20 and 40 kg/ha for its effect on the infiltration rate (IR) of two soils, a loess (Calcic Haploxeralf) and a grumusol ((Typic Chromoxerert), during simulated rainstorms. The interaction between PAM and electrolyte concentration was also investigated at the soil surface under a simulated rainfall of distilled water or tap water and by spreading gypsum. Electrolytes in the soil solutions that flocculated the soil clay enhanced the beneficial effect of the polymer on aggregate stability and greatly reduced water losses. Complete drying of the polymer-soil surfaces improved the binding action of the polymer. Treatments with PAM under optimal conditions increased the final IR of the loess from 2.0 to 23.5 mm/hr and the rain intake of an 80 mm rainstorm from 12.3 to 64.2 mm. PAM treatment of the grumusol increased the final IR from 3.0 in the control to 20.5 mm/hr and the rain intake from 21.3 to 62.3 mm. As soils from semiarid regions are unstable, form crusts, and produce much runoff (approximately 80%) during rainstorms, the use of PAM to reduce runoff is a viable possibility. (Author's abstract)
W91-00791

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

SUMMERTIME SAMPLING.
Southern Illinois Univ. at Edwardsville. Environmental Resources Training Center.
D. Anderson, and D. Bennett.
Water Engineering and Management WENMD2, Vol. 137, No. 6, p 40-41, June 1990.

Descriptors: *Bacterial analysis, *Pollutant identification, *Summer, *Water sampling, *Water treatment, Bacteria, Bacterial growth, Laboratory methods, Seasonal variation, Water analysis.

During warm temperatures, excessive noncoliform bacteria growth--after sample collection and before the sample is analyzed--does not indicate an actual problem with such noncoliform bacteria in drinking water. The problem is faulty sampling procedures for the given conditions of summer. The special conditions of summer are very favorable for excessive bacteria growth, especially for surface water supplies. To prevent bacteriological contamination of water samples in warm weather the following procedures are recommended: the service line and nearby hydrants should be flushed; the sample should be collected without changing water pressure; samples should be transported directly and packed in ice; samplers should be sure to wash their hands with soap and water before sampling and take care to select the proper type of sampling tap, preferably a smooth-nosed tap that doesn't leak and that does not have an aerator, sample should not be taken from an outside sill-cock since these are threaded and usually near the ground where they can be contaminated easily. (Mertz-PTT)
W91-00111

REPRODUCTIVE STRATEGY OF DAPHNIA MAGNA AFFECTS THE SENSITIVITY OF ITS PROGENY IN ACUTE TOXICITY TESTS.
Ministry of Transport and Public Works, Lelystad (Netherlands). Lab. for Ecotoxicology.
L. Enserink, W. Luttmer, and H. Maas-Diepeveen.
Aquatic Toxicology AQTODG, Vol. 17, No. 1, p 15-25, July 1990. 8 fig, 18 ref.

Descriptors: *Acute toxicity, *Adaptation, *Bioindicators, *Cadmium, *Chromium, *Daphnia, *Heavy metals, *Water pollution effects, Chlorophyta, Food habits, Laboratory methods, Reproducibility, Toxicology, Trace metals.

Maternal nutrition in Daphnia magna affects the body size of the young and the sensitivity of the brood for acute exposure to Cd, but not to Cr(VI). This phenomenon may contribute to inter-laboratory as well as intra-laboratory variation in test results, because Daphnia culture techniques are not yet standardized in a sufficient way. In one set of

trials four food ration levels of the green alga Chlorella pyrenoidosa were given to a cohort of adult D. magna. After eight days brood size and the size of young became adapted to the new food ration level. At low levels, small broods were produced which consisted of large neonates, whereas at high food levels many tiny young were born. In acute toxicity tests with Cd the sensitivity of the neonates appeared to be connected with their body size. The smallest young were three times more sensitive than the largest neonates, comparing the 48-h LC50. No difference in sensitivity occurred during acute exposure to Cr. (Author's abstract)
W91-00192

IN VITRO INHIBITION OF ACETYLCHOLINESTERASE FROM FOUR MARINE SPECIES BY ORGANOPHOSPHATES AND CARBAMATES.
Institut Francais de Recherche pour l'Exploitation de la Mer, Nantes. Lab. of Biochemistry.
F. Galgani, and G. Bocquene.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 243-249, August 1990. 2 fig, 1 tab, 10 ref.

Descriptors: *Bioassay, *Carbamate pesticides, *Enzymes, *Organophosphorus pesticides, *Pollutant identification, *Water pollution effects, Acetylcholinesterase, Animal metabolism, Muscle, Bioindicators, Fish, Fish physiology, Marine animals, Marine pollution, Mussels, Organophosphorus compounds, Shrimp.

Because of the sensitivity of acetylcholinesterase (ACE) to carbamates and organophosphates, the enzyme has been used as a biochemical indicator of pollution by these pesticides. A study was conducted to investigate the sensitivity of various marine animals to both organophosphates and carbamates. The study was conducted by assessing the in vitro effect of five organophosphates and three carbamates on ACE activity from the muscle of the shrimp Palaemon serratus, the fishes Scomber scomber and Pleuronectes platessa, and from the whole mussels Mytilus edulis. ACE from whole mussel was less sensitive to organophosphates than the enzyme from P. serratus and the fishes. For all organophosphates studied, sensitivity was highest for P. platessa, with its ACE being inhibited by as little as a 1 ppb concentration. With carbamates, the fish were found to be more sensitive having detection levels less than 10 micrograms/L in both species. Of all species studied, P. platessa appears to be the most sensitive for the monitoring of organophosphate and carbamate pollutant effects. (Hoskin-PTT)
W91-00206

HEAVY METAL CONTAMINATION IN THE RIVER TOAD, BUFO JUXTASPER (INGER), NEAR A COPPER MINE IN EAST MALAYSIA.
National Univ. of Malaysia, Kota Kinabalu. Faculty of Science and Natural Resources.
For primary bibliographic entry see Field 5B.
W91-00209

SELECTED QUALITY ASSURANCE DATA FOR WATER SAMPLES COLLECTED BY THE U.S. GEOLOGICAL SURVEY, IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO, 1980 TO 1988.
Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 7B.
W91-00334

PROPOSAL TO USE CHLORINE-36 FOR MONITORING THE MOVEMENT OF RADIONUCLIDES FROM NUCLEAR EXPLOSIONS.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
F. M. Phillips, S. N. Davis, and P. Kubik.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 106-113, Summer 1990. 2 fig, 5 tab, 20 ref. NSF Grant PHY-8818281.

Descriptors: *Chlorine radioisotopes, *Groundwater pollution, *Monitoring, *Nuclear explosions, *Path of pollutants, *Radioactive tracers, *Tracers, Fate of pollutants, Groundwater movement, Groundwater transport, New Mexico, Radioactive wastes, Soil contamination.

Chlorine-36 has been produced in large amounts by hundreds of nuclear explosions on the Nevada Test Site as well as 12 off-site explosions at eight locations in five states. Continued monitoring of the redistribution of radionuclides by subsurface water is of concern in most of the areas affected by the detonations. Chlorine-36 has the following advantages as a built-in tracer for this redistribution: its mobility is equal to or greater than water, its long half-life assures its continued usefulness over long periods, collection and storage of samples is simple, it is not subject to vapor transport at ordinary temperatures, its natural background is very low, and it does not form insoluble precipitates. Chlorine-36 from the Gnome event near Carlsbad, New Mexico, illustrated how chlorine-36 can be used to help study the redistribution of radionuclides in the soil profile. Chlorine-36 is also potentially useful as a tracer to study movement of contaminants around large nuclear reactor complexes and near repositories for radioactive waste. (Author's abstract)
W91-00366

SOIL-GAS SURVEYING FOR SUBSURFACE GASOLINE CONTAMINATION USING TOTAL ORGANIC VAPOR DETECTION INSTRUMENTS: PART I. THEORY AND LABORATORY EXPERIMENTATION.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
G. A. Robbins, B. G. Deyo, M. R. Temple, J. D. Stuart, and M. J. Lacy.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 122-131, Summer 1990. 15 fig, 18 ref. EPA Grant No. CR-814542-01.

Descriptors: *Gasoline, *Groundwater pollution, *Measuring instruments, *Petroleum products, *Pollutant identification, *Soil analysis, *Soil gases, Analytical techniques, Chemical analysis, Laboratory methods, Monitoring, Permeability, Subsurface water, Volatile organic compounds.

Soil-gas surveying has become an effective means to screen for subsurface gasoline contamination. Most reported studies have described the use of gas chromatographs in conducting surveys. In contrast, few published studies have described the use of total organic vapor detection (TOV) instruments in conducting surveys, despite their common use. Factors influencing the response of TOV detection instruments used in soil-gas surveying for subsurface gasoline leakage were investigated through performing theoretical assessments and laboratory experiments. Theoretical assessments indicate that TOV measurements will depend on response conditions and the relative concentration of constituents in soil gas, in addition to absolute constituent levels. Laboratory tests conducted using flame ionization, photoionization and explosimeter devices indicated that conditions influencing their responses included instrument flow rate and soil-air permeability when performing direct-probe sampling; the linear range of the instrument; the multicomponent nature of gasoline vapors; and levels of oxygen, nitrogen, carbon dioxide and relative humidity in soil air. If an instrument's response to these conditions is not taken into account, survey results may be misleading. To circumvent adverse instrument responses, a serial dilution technique was used. (Author's abstract)
W91-00368

MEASUREMENT OF BIODEGRADABLE ORGANIC MATTER AND BACTERIAL GROWTH POTENTIAL IN DRINKING WATER.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-00381

DETECTING THE BIOLOGICAL EFFECTS OF DEEP-SEA WASTE DISPOSAL.
Woods Hole Oceanographic Institution, MA.
J. J. Stegeman.
Oceanus OCEAAK, Vol. 33, No. 2, p 54-61, Summer 1990. 4 fig.

Descriptors: *Bioindicators, *Marine environment, *Marine pollution, *Path of pollutants, *Water pollution effects, Animal metabolism, Bioassay, Biochemical tests, Chlorinated hydrocarbons, Cytochromes, Fish physiology, Liver, Marine animals, Monitoring, Newfoundland, Polycyclic aromatic hydrocarbons.

Biomarkers, certain biochemical changes that signal an organism's first response to chemical pollutants, can be used to assess the biological exposure and effects of pollutants more specifically and inexpensively than other methods. Using biomarkers to investigate the deep-sea environment could provide the essential background information for monitoring the effects of wastes that are disposed of in the deep ocean. The induction of cytochrome P450 is know be a well-characterized effect of many polycyclic aromatic hydrocarbons (PAHs) and chlorinated aromatic hydrocarbons (CAHs) such as dioxins and benzofurans. A widely-distributed deep sea species, the rattail fish (Coryphaenoides armatus), was chosen to study the ability to detect deep-sea environmental contamination. Two sites about 1600 km apart in the North Atlantic were studied: Hudson Canyon off the eastern United States and Carson Canyon off Newfoundland. High levels of cytochrome P450E were found in the southern group's livers, but very low levels in the northern group's livers. Polychlorinated biphenyl levels correlated with cytochrome P450E levels. The induction indicates that CAHs or other chemicals are present at levels high enough to cause this biochemical effect in animals far removed from known point-sources of the chemicals. In another collection of rattail fish near a deep-water (2500 m) dumpsite off the U.S. eastern seaboard, high levels of cytochrome P450E induction were also detected. In the future, biomarkers such as cytochrome P450E could supplant analytical chemistry as a first screen for the presence of many chemical contaminants such as PAHs and CAHs. Thus biomarkers could become a key component in any system to monitor disposal sites for chemically-induced biological change. (Hoskin-PTT)
W91-00386

DETERMINATION OF GOLD AT FEMTOMOLAR LEVELS IN NATURAL WATERS BY FLOW INJECTION INDUCTIVELY COUPLED PLASMA QUADRUPOLE MASS SPECTROMETRY.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
For primary bibliographic entry see Field 2K.
W91-00388

DETERMINATION OF CHLOROANILINE TRACES IN ENVIRONMENTAL WATERS BY SELECTIVE EXTRACTION WITH TWO TRAPS IN TANDEM AND LIQUID CHROMATOGRAPHY.
Rome Univ. (Italy). Dipt. di Chimica.
A. Di Corcia, and R. Samperi.
Analytical Chemistry ANCHAM, Vol. 62, No. 14, p 1490-1494, July 15, 1990. 1 fig, 5 tab, 17 ref.

Descriptors: *Analytical methods, *Chemical analysis, *Chlorinated hydrocarbons, *Chromatography, *High performance liquid chromatography, *Pollutant identification, *Water analysis, Adsorbents, Cation exchange, Chloranilines, Detection limits, Laboratory methods, Water quality monitoring.

Selective liquid-solid extraction from environmental waters of 14 chloroanilines was achieved using a two-trap tandem system, one containing a nonspecific absorbing material, such as graphitized carbon black (Carbopack B), and the other one filled with a resin-based strong cation exchanger. After percolation of water samples through the Carbopack column (extraction cartridge) the two traps were connected in series, acetonitrile acidi-

fied with HCl (10 mmol/L) was allowed to flow along them, and chloroanilines displaced from the extraction cartridge were selectively readsorbed via hydrogen bonding on the strong acid exchanger column (isolation cartridge). After this column was washed, the analytes were eluted from the isolation cartridge with 1 ml of aqueous acetonitrile KOH (0.1 mol/L) solution. After suitable neutralization, 0.2 ml of this solution was directly injected into the liquid chromatographic apparatus, which was operated isocratically in the reverse-phase mode with UV detection at 240 nm. The analytical recoveries of the 14 chloroanilines were higher than 88%. The limits of detection of the analytes considered were well below 0.1 microg/L. The effectiveness in terms of recovery and selectivity of the two traps in a series was superior compared with the cartridges used individually, or with a third cartridge which contained a chemically bonded siliceous material. (Author's abstract)
W91-00389

AUTOMATED HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY FOR THE DETERMINATION OF PESTICIDES IN WATER USING SOLID PHASE EXTRACTION.
Brock Univ., St. Catharines (Ontario). Dept. of Chemistry.
C. H. Marvin, I. D. Brindle, C. D. Hall, and M. Chiba.
Analytical Chemistry ANCHAM, Vol. 62, No. 14, p 1495-1498, July 15, 1990. 4 fig, 2 tab, 10 ref.

Descriptors: *Analytical methods, *Chemical analysis, *Chromatography, *High performance liquid chromatography, *Pesticides, *Pollutant identification, *Water analysis, Adsorbents, Automation, Detection limits, Laboratory methods, Water quality monitoring.

An automated solid phase extraction/high performance liquid chromatography (SPE/HPLC) method has been developed to determine trace concentrations of Propoxur, Carbofuran, Carbaryl, Propham, Captan, Chloropropham, Barban, and Butylate in water. One hundred ml of sample is passed through a disposable SPE cartridge packed with 90 microm sorbent at 10 ml/min. The concentrated analytes are eluted from the cartridge with acetonitrile. The resulting eluate is blown down under nitrogen, made up in water, and injected into the HPLC. The analytes are separated on a 25 cm C(8) analytical column and determined by UV absorption at 220 nm. The total time for the analysis is 90 min and the lowest detectable concentrations are in the range of 0.02-0.92 microg/L for the eight pesticides. Recoveries for the eight pesticides ranged from 84-93%. The procedure is totally automated and can analyze 30 samples consecutively and unattended. (Author's abstract)
W91-00390

PERFORMANCE EVALUATION MATERIALS FOR THE ANALYSIS OF VOLATILE ORGANIC CONTAMINANTS IN SOIL: A PRELIMINARY ASSESSMENT.
Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV.
T. E. Lewis, B. A. Deason, C. L. Gerlach, and D. W. Bottrell.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 5, p 505-531, July 1990. 4 fig, 7 tab, 24 ref. EPA Contract 68-03-3249.

Descriptors: *Analytical methods, *Chemical analysis, *Pollutant identification, *Soil analysis, *Volatile organic compounds, Gas chromatography, Mass spectrometry, Performance evaluation, Quality control, Sample preparation, Soil contamination, Stability analysis, Static headspace.

The performance of an analytical method may vary significantly as a result of the diverse nature of sample matrices. During an evaluation of field portable gas chromatographs (GC), site-specific performance evaluation materials (PEM) were prepared and used as quality control samples. Clean soils from two contaminated sites were spiked with various volatile organic compounds. The PEM were shipped to the field via air carrier and analyzed by GC. The PEM samples were also shipped back to the laboratory and analyzed as double blind samples on a GC and a GC/mass spectrometer. PEM samples which were held in the laboratory without being shipped were also analyzed. GC analyses with a static headspace method revealed highly variable recoveries for both shipped and unshipped PEM. An operationally defined headspace calibration was used to quantitate the amount of analyte remaining in the soil at various holding times and under various shipping scenarios. Several factors were critical in the preparation and long term integrity of soil volatile PEM: moisture status of the soil, sample aging, chemical characteristics of the spiked analytes, storage container, and spiking solution. (Author's abstract)
W91-00393

CURRENT STATUS OF DISINFECTANT RESIDUAL MEASUREMENT METHODS FOR FREE AND COMBINED CHLORIDE AND OXYCHLORINE SPECIES.
Miami Univ., Oxford, OH. Dept. of Chemistry.
G. Gordon, G. E. Pacey, and W. J. Cooper.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 29-45, 1 fig, 27 ref.

Descriptors: *Chemical analysis, *Chlorides, *Chlorination, *Data acquisition, *Pollutant identification, *Residual chlorine, *Water analysis, Amperometry, Chloramines, Disinfection, Laboratory methods, Syringaldazine, Water treatment.

A detailed report was written for the American Water Works Association Research Foundation, which reviews and summarizes all disinfectant residual measurement techniques currently available for free chlorine (along with the various chloramines), combined chlorine, chlorite ion, chlorine dioxide, and chlorate ions. A common problem with chemical methods for determination of disinfection species is that there is no ideal or referee method that can be used to check the accuracy of the new ones being developed and tested. The ideal method for determination of chlorine would accurately measure free aqueous chlorine (Cl2 + HOCl) in all types of water samples. Even though HOCl is the disinfecting species that appears to be most effective, almost all methods determine both species simultaneously. The ideal method should work equally well for all water samples. There is a great need for extremely selective analytical methods capable of determining not only chlorine but the individual chloramines and other oxychlorinated species. In general, because the molar absorptivities are quite low for chlorine and chloramine species, current methods are not considered useful in routine monitoring of chlorine residuals. It is possible that additional methods using permeable membranes, such as gas diffusion flow-injection analysis, could be developed for simultaneous determination of chlorine species in aqueous solution. Amperometric titration techniques will probably remain the laboratory standard used as the basis for comparisons of accuracy. The FACTS test, which uses syringaldazine, appears to be very useful for determination of free chlorine in the presence of relatively high concentrations of combined inorganic chlorine. A severe drawback of the FACTS test procedure is the insolubility of the syringaldazine in either 2-propanol or water. Both fluorescence and chemiluminescence methods show promise for specific determination of free chlorine at very low concentrations. Neither the iodometric or amperometric methods are recommended because they are unreliable. (See also W91-00476) (Lantz-PTT)
W91-00479

EVALUATION OF PROTOCOL FOR PREPARING DRINKING WATER SAMPLES FOR AMES MUTAGENICITY TESTING.
California Dept. of Health Services, Berkeley.
Y. Y. Wang, C. P. Flessel, K. I. Chang, D. A. Hollander, and P. J. Marsden.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 261-277, 29 ref.

Descriptors: *Ames test, *Chlorination, *Disinfection, *Drinking water, *Laboratory methods, *Mutagens, *Sample preparation, *Water analysis, *Water quality control, California, Water sampling.

Studies on the isolation and quantitation of the semivolatile and nonvolatile residue organics have been difficult to compare because suitable sample preparation and measurement procedures have not been validated and standardized. A protocol detailing the preparation of drinking water samples for Ames mutagenicity testing was published under the sponsorship of the EPA. A modification of the consensus EPA protocol was used for preparing drinking water samples collected from 5 different northern California sites. These sites delivered samples from both surface-water and groundwater, and all were chlorinated. Improvements were made by adjusting the pH to 2 before column extraction. Acidifying the water samples increased the yield of organic residues and mutagenic responses. The precision of the modified method, based on a single comparison of two identical aliquots of drinking water processed simultaneously, was approximately 14%. Temporal variation in mutagenicity of samples from a single collection site ranged from 2 to 46%. Recovery of a spiked standard was also higher at pH 2. Based on experiments with a water-soluble mutagen, 4-NBA, the recovery efficiency ranged from 75-91%. Further work is required to establish the accuracy of the modified method for the recovery of other soluble mutagens. (See also W91-00476) (Lantz-PTT)
W91-00496

MEASUREMENT OF CHLORINE RESIDUALS IN CHLORINATED COOLING WATERS: EFFECT OF ORGANIC NITROGEN.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00517

TRIHALOMETHANE FORMATION POTENTIAL AND ORGANIC CONTENT: A NEW ANALYTICAL APPROACH.
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
For primary bibliographic entry see Field 5F.
W91-00524

IDENTIFICATION OF ORGANIC N-CHLORAMINES IN WASTEWATER.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
E. Choshen, J. D. Johnson, F. E. Scully, J. A. Jersey, and J. T. Jewell.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. V 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, TN, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, MI. 1989. p 751-761, 5 fig, 1 tab, 29 ref. National Science Foundation Grant ECE-8415255, Electric Power Research Institute Grant Number RP2300-7.

Descriptors: *Chloramines, *Chlorination, *Laboratory methods, *Organic compounds, *Pollutant identification, *Water pollution control, Amino acids, Chemical analysis, Gas chromatography, High performance liquid chromatography, Mass spectrometry, Wastewater, Water quality.

Free amino compounds are known to occur in sewage. During chlorination of water, amino compounds are converted rapidly and quantitatively to their N-chloro derivatives. Therefore a discussion of nitrogenous organic compounds in chlorinated wastewater must be directed to organic N-chloramines and N-chloramino acids rather than to free amino compounds. Organic N-chloramines have

widely ranging stabilities, with half lives ranging from minutes to weeks. Because they are thermally labile or readily undergo decomposition when concentrated or isolated from solution, organic chloramines are not likely to withstand the harsh conditions of concentration, gas chromatographic separation, and mass spectrometric identification conventionally used to identify trace organics. A combination of separation and detection techniques (high performance liquid chromatography and gas chromatography/mass spectrometry) has resulted in a method for confirmed identification of individual N-chloramines in water. The use of this method has enabled the first confirmed identification of N-chloro compounds in wastewater. Breakpoint chlorination resulted in a significant decrease in the number of detected products over chlorination to the chloramine maximum. The procedure reported here can be applied to various waters and wastewaters. It can be used for future qualitative studies of N-chloro compounds and a better understanding of the chemistry of organic N-chloramines. (See also W91-00476) (Lantz-PTT)
W91-00533

CHLORINE AND MONOCHLORAMINE MEASUREMENTS USING A PULSED SILVER IODIDE ELECTRODE.
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
T. N. Morrison, and C. O. Huber.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 795-799, 1 fig, 1 tab, 5 ref.

Descriptors: *Chlorination, *Chlorine, *Electrodes, *Measuring instruments, *Pollutant identification, *Water quality control, *Water treatment, Chemical reactions, Chlorinated hydrocarbons, Hydrogen ion concentration.

Protection from infectious diseases dictates chlorination, yet the toxic and mutagenic effects of chlorinated organics produced in natural water requires the use of minimal concentrations of residual active chlorine. In most potable water, surface water, or wastewater samples, the most important chlorine species typically use reduction of the chlorine by a standardized reductant, often with iodide as an intermediate or catalytic reducing agent. The work reported here presents an analytical measurement based on direct reduction rates by iodide at the electrode surface. Selectivity is based on pH effects on the relative rates of hypochlorous vs. monochloramine reduction. Measurement of the rate constant for the formation of monochloramine at realistically low concentrations and ionic strengths is demonstrated. Selectivity for hypochlorous acid over monochloramine was obtained by controlling the pH. The forward rate constant for the monochloramine-iodide reaction is smaller than for the hypochlorous acid-iodide reaction. At pH > 5 no measurable current is observed for monochloramine, while below pH 3 the current due to monochloramine is equivalent to the current for hypochlorous acid. The sensitivity for hypochlorous acid is invariant from pH 2.5 to 5.5. This facilitates the subtraction of the hypochlorous acid component for a mixture by measuring first at pH 5.5 and then at pH 3. Selected conditions and analytical characteristics of flow injection concentration measurements showed linear response. Analytical measurements were obtained by operators with a range of technical background in order to evaluate the dependence of precision on operator expertise. (See also W91-00476) (Lantz-PTT)
W91-00536

CHLORAMINE INTERFERENCE IN THE MEASUREMENT OF FREE CHLORINE BY THE AMPEROMETRIC MEMBRANE ELECTRODE.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W91-00537

AUTOMATED PRECONCENTRATION OF TRACE METALS FROM SEAWATER AND FRESHWATER.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
For primary bibliographic entry see Field 7B.
W91-00615

AUTOMATED DETERMINATION OF SILICA IN SURFACE AND GROUND WATER (DIE OUTOMATIESE BEPALING VAN SILIKA IN OPPERVLAK EN GRONDWATER).
Pretoria Univ. (South Africa). Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W91-00638

SYNCHRONOUS FLUORESCENCE SPECTROSCOPY OF DISSOLVED ORGANIC MATTER IN SURFACE WATERS: APPLICATION TO AIRBORNE REMOTE SENSING.
Cornell Univ., Ithaca, NY. Cornell Lab. for Environmental Applications of Remote Sensing.
A. Vodacek.
Remote Sensing of the Environment RSEEA7, Vol. 30, No. 3, p 239-247, Dec 1990. 3 fig, 26 ref.

Descriptors: *Dissolved solids, *Fluorescence, *Lakes, *Remote sensing, *Spectroscopy, *Surface water, *Water analysis, Analytical methods, Data interpretation, Lignin, Michigan, New York, Regression analysis, Spectral analysis, Wavelengths, Wisconsin.

Synchronous fluorescence spectroscopy of dissolved organic matter (DOM) in surface waters was investigated as a method of inferring DOM composition. The synchronous fluorescence technique, which has been previously shown to provide structural information for polycyclic hydrocarbons, including crude oils, has been extended to DOM as a method for 'fingerprinting' humic substance (HS) types. Fluorescence emission and synchronous fluorescence data were collected for 21 lake water samples, 10 from lakes in the Adirondack Mountains of New York and 11 from lakes in northern Michigan and northern Wisconsin. The lake sample synchronous spectra, which are compared with synchronous spectra of lignin and data derived from the literature of other model compounds, provide new insights into the structure of surface water DOM. Further support for this approach is provided by a comparison between the multiple linear regression result found when relating measured pH to fluorescence emission data (R squared = 0.75) and that found when relating the measured pH to synchronous fluorescence data (R squared = 0.90.). Adapting the synchronous fluorescence spectral technique to a remote sensing context is discussed in terms of using the method for choosing optimal excitation wavelengths for a multiple-wavelength lidar. A lidar with a limited number of excitation wavelengths may be sufficient if key excitation-emission pairs can be identified for a particular application. For example, a lidar that could excite sequentially at 286 nm, 350 nm, and 387 nm, and measure the three respective emission spectra with an array spectrograph could provide similar data to that obtained from the synchronous spectra in this study. (Author's abstract)
W91-00639

USE OF EXTANT POPULATIONS OF SCALED CHRYSOPHYTES FOR THE INFERENCE OF LAKEWATER PH.
Connecticut Coll., New London. Dept. of Botany.
P. A. Siver, and J. S. Hamer.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1339-1347, July 1990. 2 fig, 3 tab, 41 ref. U.S. Department of the Interior Grant 14-08-0001-G1412-04.

Descriptors: *Acid lakes, *Acid rain, *Bioindicators, *Chrysophyta, *Connecticut, *Limnology, *Model studies, *Paleolimnology, Cluster analysis, Hydrogen ion concentration, Long-term studies, Monitoring, Regression analysis, Statistics.

Abundance of living populations of scaled chrysophytes were used to develop multiple regression models for inferring lakewater pH. Until now, all such inference models had been prepared with surface sediment remains and used to reconstruct historical (down-core) changes. Highly significant models can be prepared from living populations of scaled-chrysophytes that could be valuable for monitoring chronic, episodic and/or long-term changes in lakewater pH. Average weighted-mean pH and a cluster analysis technique were used to divide 33 taxa found in 26 Connecticut lakes into groups according to their distribution along a pH gradient. Two calculations of average weighted-mean pH were made: one based on data from this study and another based on literature records. Inference models were developed using a single sample from each lake as well as for multiple samples collected throughout the year. The best model based on a single discrete sample yielded and R-squared of 0.58 ($p<0.05$); multiple samples from each lake yielded significantly higher R-squared values (between 0.75 and 0.83). Scaled chrysophytes appear to be very valuable assemblage of indicator organisms for the long-term monitoring of lakes. (Author's abstract)
W91-00658

ARSENATE SENSITIVITY IN MARINE PERIPHYTON COMMUNITIES ESTABLISHED UNDER VARIOUS NUTRIENT REGIMES.
Goeteborg Univ. (Sweden). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W91-00700

USING SEABIRDS TO MONITOR MERCURY IN MARINE ENVIRONMENTS: THE VALIDITY OF CONVERSION RATIOS FOR TISSUE COMPARISONS.
Glasgow Univ. (Scotland). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W91-00704

RAPID METHOD FOR ASSESSING GROWTH RATES OF CORAL IN RELATION TO WATER POLLUTION.
Glasgow Univ. (Scotland). Dept. of Zoology.
P. S. Davies.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 346-348, July 1990. 2 tab, 20 ref.

Descriptors: *Animal growth, *Bioassay, *Bioindicators, *Corals, *Water pollution effects, Animal metabolism, Buoyant weighing, Nitrates, Nitrites, Phosphates.

The rates of growth of small pieces (nubbins) of the branching coral (Porites porites) and of cores taken from the massive coral (Montastrea annularis) were measured on a gradient of eutrophication in Barbados. Growth rate was determined using the buoyant weighing technique. This technique enabled growth to be measured after only three days in Porites and seven days in Montastrea. P. porites showed no difference in growth rate associated with elevated nitrite/nitrate or phosphate levels, while the growth of M. annularis was significantly reduced. These preliminary experiments suggest that the buoyant weighing technique is suitable for further development as a bioassay for coral reefs subjected to environmental pollution, although the coral species used may have to be chosen with care. (Author's abstract)
W91-00705

EVALUATING THE PROBABILITY OF VIOLATING DISSOLVED OXYGEN STANDARD.
Wyoming Water Research Center, Laramie.
For primary bibliographic entry see Field 5G.
W91-00715

COMPARATIVE STUDY OF TOXIC LEAD EFFECT ON GILL AND HEMOGLOBIN OF TILAPIA FISH.
Instituto Politecnico Nacional, Mexico City. Dept. de Farmacologia y Toxicolgia.
L. M. Tabche, C. M. Martinez, and E. Sanchez-Hidalgo.
Journal of Applied Toxicology JJATDK, Vol. 10,

No. 3, p 193-195, June 1990. 3 fig, 27 ref.

Descriptors: *Bioassay, *Lead, *Pollutant identification, *Toxicity, *Water pollution effects, Bioindicators, Comparison studies, Gills, Hemoglobin, Membranes, Tilapia.

A study was designed to determine the 72-hr LC50 of lead for tilapia fish (Oreochromis hornorum) as well as the effect of exposure to sublethal lead concentrations (15, 23, 39, and 47% of the LC50) on gill tissue lysosomal membranes of the fish and the hemoglobin concentration in the blood. The LC50 was 202 mg Pb(2+)/L. Exposure to sublethal lead concentrations for 72 hr showed significant increases in the lability of gill lysosomal membranes, measured by the release of acid phosphatase. Changes in membrane lability and in hemoglobin concentration depended on the amount of lead used during the exposure. Membrane lability is concluded to be an adequate parameter to assay for monitoring lead contamination in water because it is more sensitive than the hemoglobin concentration in blood. (Author's abstract)
W91-00722

DETERMINATION OF WARFARIN IN DRINKING WATER BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY AFTER SOLID-PHASE EXTRACTION.
Gacell Labs. A.B., Malmo (Sweden). Analytical and Quality Development Dept.
J. Dalbacke, I. Dahlquist, and C. Persson.
Journal of Chromatography JOCRAM, Vol. 507, p 381-387, May 1990. 2 fig, 2 tab, 10 ref.

Descriptors: *High performance liquid chromatography, *Pesticides, *Pollutant identification, *Rodenticides, *Warfarin, *Water analysis, Drinking water, Performance evaluation, Standards.

Warfarin (4-hydroxy-3-(3-oxo-1-phenylbutyl)coumarin) is used both as an anticoagulant in man and as a rodenticide. According to EEC guidelines, the concentration of warfarin in drinking water must not exceed 0.1 ppb (0.1 micrograms/L). A method was therefore developed for the determination of 0.1 microgram/L of the warfarin in drinking water. A 1000-ml volume of drinking water was aspirated through a solid-phase extraction column and warfarin was eluted to 1.0 ml. The eluate was analyzed using reversed-phase high-performance liquid chromatography with UV detection. The detection limit was 0.02 microgram/L. Recoveries exceeding 90% were obtained from tap water spiked with warfarin. (Author's abstract)
W91-00723

DETERMINATION OF FUNGISTATIC QUATERNARY AMMONIUM COMPOUNDS IN BEVERAGES AND WATER SAMPLES BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY.
Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Elintarvikelaboratorio.
T. Suortti, and H. Sirvio.
Journal of Chromatography JOCRAM, Vol. 507, p 421-425, May 1990. 1 fig, 1 tab, 4 ref.

Descriptors: *Food analysis, *Fungicides, *High performance liquid chromatography, *Pollutant identification, *Water analysis, Performance evaluation, Quaternary ammonium compounds.

Fungistatic and fungicidal quaternary alkylammonium compounds are used widely to prevent staining of timber and may be applied to restrict growth of fungi in barley. Although these compounds show only low toxicity, sensitive methods are required for their determination as trace contaminants in food products and water. Problems arise in their analysis because they are of low volatility, do not carry a chromophore, and are difficult to derivatize. The present study aimed to develop a method of determining quaternary alkylamines at the microgram/ml level. An anomalous effect was observed of the concentration of ion-pairing agent on C18 and CN columns. Normally, an ion-pairing effect would induce an increase in retention, but with benzene sulfonic acid the opposite effect was seen. Thus, the concentration in the aqueous effluent of either didecyldimethylammonium (DE) or dodecyltrimethylammonium (DO) decreased as the concentration of benzene sulfonic acid and methanol employed increased. Using this phenomenon in high-performance liquid chromatography enabled the recovery of quaternary alkylammonium compounds at the 70% level from beer spiked at the 25 mg/L, 64% from wort, and 68% from water spiked at the 50 mg/L. (Rochester-PTT)
W91-00724

DETERMINATION OF BORATE AT TRACE LEVELS IN ENVIRONMENTAL SAMPLES BY ION-EXCLUSION CHROMATOGRAPHY.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
H. C. Mehra, K. D. Huysmans, and W. T. Frankenberger.
Journal of Chromatography JOCRAM, Vol. 508, No. 1, p 265-270, May 25, 1990. 2 fig, 2 tab, 10 ref.

Descriptors: *Borates, *High performance liquid chromatography, *Phytotoxicity, *Pollutant identification, *Water analysis, Boron, Colorimetry, Comparison studies, Performance evaluation, Soil chemistry, Water chemistry.

Boron can be toxic to higher plants when present in the soil solution (0.5-5.0 microgram/ml) not much greater than trace amounts needed for normal growth. Boron toxicities are more prevalent than boron deficiencies among crops grown on saline soils. Boron in drinking water in many regions of the world has been reported to be 100 microgram/L or less. Ion-exclusion chromatography was employed for the determination of borate in soils, sediments, and water samples using D-sorbitol in the mobile phase. This method also has applications in the determination of bicarbonate. Two ion-exclusion columns were evaluated for their efficiencies in separation of borate. This ion-exclusion chromatography technique enables separation, detection, and quantification of borate from various matrices obtained from several experimental problem sites. Results obtained by ion-exclusion chromatography were close to those obtained by the colorimetric azomethine-H procedure in determination of borate in soil, sediment, and lake water samples. (Rochester-PTT)
W91-00725

DETERMINATION OF RESIN AND FATTY ACIDS IN PULP AND PAPER MILL EFFLUENTS AND WHITE WATERS BY GAS-LIQUID CHROMATOGRAPHY.
Ukrainskii Nauchno-Issledovatel'skii Inst. Tselliuloznoii Bumazhno Promyshlennosti, Kiev (USSR).
O. Kalchenko, and W. P. Svitelsky.
Journal of Chromatography JOCRAM, Vol. 509, No. 1, p 65-68, June 15, 1990. 2 fig, 1 tab, 5 ref.

Descriptors: *Gas liquid chromatography, *Organic compounds, *Pollutant identification, *Pulp wastes, *Wastewater analysis, Performance evaluation, Qualitative analysis, White water.

Studies on the composition of organic compounds accumulating in white waters from the pulp and paper industry can contribute to their efficient removal and lower discharge loads. Gas-liquid chromatography (GLC) has been used successfully for monitoring organic components. The compositions of organic components extracted with chloroform-diethyl ether from white waters from thermomechanical pulping of spruce, the filtrate of a bleached kraft pulp suspension (pine), and effluents from a board mill and waste paper recycling plant (1:1) were investigated. Organic substances (phenols, aromatic acids, aliphatic acids, and resin acids) were determined by an internal standard procedure (methyl stearate standard). Qualitative analysis was performed by comparing the elution times of substances on the chromatograms with those of standard substances. (Rochester-PTT)
W91-00726

SIMPLE DEVICE FOR THE DETERMINATION OF VOLATILE CHLORINATED HYDROCARBONS IN WATER BY GAS CHROMATOGRAPHY.
Vyzkumny Ustav Vodohospodarsky, Prague (Czechoslovakia).
B. Uchytil, and J. Munich.
Journal of Chromatography JOCRAM, Vol. 509, No. 1, p 111-113, June 15, 1990. 2 fig, 4 ref.

Descriptors: *Chlorinated hydrocarbons, *Gas chromatography, *Pollutant identification, *Trace levels, *Water analysis, Benzene, Headspace method, Microcartridges, Toluene.

In trace analysis, methods for concentrating analyte compounds from the sample are often needed. The dynamic headspace method is suitable, but requires a special accessory (a furnace with a control unit for thermal desorption of analytes). A simple device was designed for collecting analyte compounds in a preconcentration microcartridge, which can be inserted into the injector of any gas chromatograph with a sufficiently wide injector, without interruption of the gas flow. The method was applied to the determination of volatile chlorinated hydrocarbons in water. The analyte compounds were isolated from a 50-ml water sample by the dynamic headspace method by concentration on the microcartridge and inserted into the injector of the gas chromatograph. The minimum concentration of chloroform, 1,2-dichloroethane, perchloroethylene and trichloroethylene that can be determined is 0.2 micrograms/L; of chlorobenzene, 1,2-, and 1,4-dichlorobenzene 0. micrograms/L; and of benzene and toluene 0.05 micrograms/L. (Rochester-PTT)
W91-00727

SIMULTANEOUS DETERMINATION OF NITRITES, NITRATES AND AMINES BY ION-INTERACTION REVERSED-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY.
Turin Univ. (Italy). Dipt. di Chimica Analitica.
M. C. Gennaro, and P. L. Bertolo.
Journal of Chromatography JOCRAM, Vol. 509, No. 1, p 147-156, June 15, 1990. 5 fig, 4 tab, 8 ref.

Descriptors: *High performance liquid chromatography, *Nitrogen compounds, *Pollutant identification, Amines, Nitrates, Performance evaluation.

The conditions for the simultaneous separation of aliphatic and aromatic amines, nitrites, and nitrates by ion-interaction reversed-phase high-performance liquid chromatography (HPLC) were optimized. The mechanism that governs retention in this HPLC technique was considered and it was concluded that the alkyl chain length of the ion-interaction reagent has the greatest influence on retention. Sensitivity of the order of 0.10 ppm for nitrites and nitrates can be obtained with octylamine orthophosphate as eluent at 210 nm. Amounts of 0.20 ppm of nitrates and 0.50 ppm of 1,4-phenylenediamine can be identified easily and determined in matrices as complex as sea water. (Author's abstract)
W91-00728

DISTRIBUTION AND CORRELATION OF ELEMENTS IN WATERS, SUSPENSIONS, SEDIMENTS, AND MARINE ORGANISMS FROM THE BLACK SEA.
Bulgarian Academy of Sciences, Varna. Inst. of Oceanography.
G. Andreev, and V. Simeonov.
Toxicological and Environmental Chemistry TXECBP, Vol. 28, No. 1, p 1-9, 1990. 5 fig, 8 tab, 6 ref.

Descriptors: *Black Sea, *Indicators, *Marine environment, *Path of pollutants, *Water pollution effects, *Water pollution sources, Bottom sampling, Correlation analysis, Inorganic compounds, Marine life, Monitoring, Statistical analysis, Suspended sediments.

The simultaneous study of the distribution of chemical components in various marine environment samples allows a more effective evaluation of the complex ecological equilibrium. For this reason, the distribution of several ecologically important elements in Black Sea waters, suspensions,

sediments, and marine organisms (Mytilus gallprovincialis and Gobin niger) was studied using five sampling profiles. The stations were located at different distances from an anthropogenic source. A correlation analysis was carried out that showed a significant relationship between the elements in consideration both within and between the marine phases. The correlated analysis also indicated a higher correlation among the natural process of elemental accumulation: from waters and suspended material to the thin surface layer and, then, to sediments and living organisms. The correlation analysis also showed the significance of the sediments for metal accumulation in bottom-dwelling marine organisms. The investigation also determined that the best way to study anthropogenic effects in a sea region is to use mainly organisms and sediments as pollution indicators. Both types of samples show the steady trends in the element distribution quite satisfactorily. Water samples and suspended matter are more unstable with respect to distribution effects and undergo more short-term fluctuations. (Korn-PTT)
W91-00797

ENVIRONMENTAL RUSSIAN ROULETTE: COMPLIANCE AT OR NEAR THE DETECTION LEVEL.
Nixon, Hargrave, Devans and Doyle, Rochester, NY.
For primary bibliographic entry see Field 5G.
W91-00802

DISTRIBUTION AND TRANSPORT OF SEDIMENT-BOUND METAL CONTAMINANTS IN THE RIO GRANDE DE TARCOLES, COSTA RICA (CENTRAL AMERICA).
Geological Survey, Menlo Park, CA.
C. C. Fuller, J. A. Davis, D. J. Cain, P. J. Lamothe, and T. L. Fries.
Water Research WATRAG, Vol. 24, No. 7, p 805-812, July 1990. 7 fig, 3 tab, 21 ref.

Descriptors: *Chromium, *Costa Rica, *Heavy metals, *Lead, *Path of pollutants, *Sediment contamination, *Water pollution sources, *Zinc, River beds, River sediments, Sediment analysis, Sediment transport.

A reconnaissance survey of the extent of metal contamination in the Rio Grande de Tarcoles river system of Costa Rica indicated high levels of chromium (Cr) in the fine-grained bed sediments (< 60 micro m) of tributaries downstream from leather tanneries (50-83 times Cr background or 3000-5000 micro g/g). In the main channel of the river downstream of the Sane Jose urban area Cr contamination in sediments was 4-6 times background and remained relatively constant over 50 km to the mouth of the river. Sediments from a mangrove swamp at the river mouth had Cr levels 2-3 times above background. Similar patterns of dilution were observed for lead (Pb) and Zinc (Zn) sediment contamination although the contamination levels were lower. The high affinity of Cr towards particulate phases, probably as Cr(III), allows the use of Cr contamination levels for delineating regions of deposition of fine-grained sediments and dilution of particle associated contaminants during transport and deposition. (Author's abstract)
W91-00804

MICROBIAL SENSOR FOR BOD.
Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Molekularbiologie.
K. Riedel, K. P. Lange, H. J. Stein, M. Kuhn, and P. Ott.
Water Research WATRAG, Vol. 24, No. 7, p 883-887, July 1990. 8 fig, 4 tab, 12 ref.

Descriptors: *Biochemical oxygen demand, *Instrumentation, *Pollutant identification, *Sensors, *Water analysis, Biodegradation, Electrodes, Experimental design, Microbial degradation, Microorganisms, Wastewater.

Biochemical oxygen demand (BOD) is a widely used parameter for the determination of biodegradable organic compounds in wastewater. The conventional BOD test takes 5 days and is thus unsuitable for process control. A more rapid estimation of BOD is possible by using a microbial sensor containing whole cells immobilized on an oxygen electrode. Most BOD sensors use the stationary state measurement and show a response time of 15-29 min, but it is possible to use the dynamic or kinetic mode (differential current time curve method) for the determination of BOD with microbial sensors. These sensors measure the respiration acceleration rate by the change in electric current and allow a response time of less than 1 min. A microbial amperometric sensor to determine the biochemical oxygen demand was developed using Trichosporon cutaneum cells immobilized in polyvinylalcohol. This sensor measured BOD with a very short response time (<30 s), an operation stability of 48 days and a serial coefficient of variation of 3.3% when a sample solution containing 22 mg/L BOD was used. A linear range of up to 100 mg/L BOD was obtained using a glucose/glutamic acid standard. The sensitivity and specificity was increased by incubating the BOD sensor with the respective wastewater. Comparable results were obtained for BOD values estimated by the biosensor and those determined by the 5-day method. (Korn-PTT)
W91-00812

SIMPLE CONTINUOUS-FLOW TOXICITY TEST SYSTEM FOR MICROSCOPIC LIFE STAGES OF AQUATIC ORGANISMS.
California Univ., Santa Cruz. Inst. of Marine Sciences.
M. M. Singer, D. L. Smalheer, and R. S. Tjeerdema.
Water Research WATRAG, Vol. 24, No. 7, p 899-903, July 1990. 4 fig, 1 tab, 11 ref.

Descriptors: *Bioassay, *Testing procedures, *Toxicity, Biochemical oxygen demand, Instrumentation, Microorganisms, Organic compounds, Volatile organic compounds.

A flow-through toxicity testing system utilizing a new exposure chamber designed for microscopic organisms was developed. Typically, flow-through testing is conducted with either a serial or proportional diluting system. While generally relying on gravity to drive water flow, as different amounts of toxicant and diluent are combined in glass or plexiglass mixing cells, they are almost always open to the surrounding atmosphere. In contrast, the system described here is based on a simple exposure design utilizing premixed stocks representing each exposure concentration. While the system is entirely closed to the surrounding atmosphere, for testing of volatile organic mixtures in addition to nonvolatile inorganic toxicants, the delivery manifold may be aerated for toxicants of low volatility and high biochemical oxygen demand (BOD). The system incorporates flexible Teflon gas sampling bags for stock preparation and storage (thus avoiding the need for a headspace), and digital unified-drive peristaltic pumps for controlled toxicant delivery. To reduce surface partitioning of toxicants, all system components are constructed of chemically inert materials (Teflon, glass, and silicone). (Author's abstract)
W91-00814

SEQUENTIAL INOCULATION AS AN ADJUNCT IN ENTERIC VIRUS PLAQUE ENUMERATION.
Environmental Protection Agency, Cincinnati, OH.
W. H. Benton, and C. J. Hurst.
Water Research WATRAG, Vol. 24, No. 7, p 905-909, July 1990. 4 tab, 7 ref.

Descriptors: *Culturing techniques, *Laboratory methods, *Pollutant identification, *Viruses, Data acquisition, Enteroviruses, Experimental design, Iododeoxyuridine.

Monitoring enteric viruses present in source waters and drinking water involves physically concentrating viruses from the water sample into a smaller and more manageable volume. Efficient enumeration of the concentrated viruses is the crucial second step, where perhaps the utmost consideration is selection and use of host cell lines that are most sensitive for supporting replication of those viruses present in the sample. The potential utility of sequentially inoculating a virus sample onto two different cultures of similar vs. dissimilar cell lines was evaluated in conjunction with IDU (5-iodo-2-deoxyuridine) treatment of the cells as a potential adjunct in viral plaque formation assays. This evaluation was done using laboratory grown human echovirus 7, human enterovirus 69 and human poliovirus 1, plus an environmental concentrate derived from sewage that contained indigenous untyped enterovirus. The cell lines employed were BGM, RD, L-132, and HEL-299. Sequential inoculation generally yielded higher viral assay titers when compared with the more traditional method of simply introducing viral inoculum onto a culture of the first (initial) cell line and then completing the assay without removing that inoculum. When a permissive cell line (BGM or RD) was used for both the initial and final cultures in a sequential inoculation technique, the total plaque count titer from both the initial plus final cultures represented an average 35% improvement over the traditional method. (Author's abstract)
W91-00815

BIOMONITORING OF CHEMICALS ON TROPICAL ECOSYSTEMS.
Universitaet des Saarlandes, Saarbruecken (Germany, F.R.). Inst. fuer Biogeographie.
For primary bibliographic entry see Field 5B.
W91-00823

DETECTION OF VIBRIO CHOLERAE O1 IN THE AQUATIC ENVIRONMENT BY FLUORESCENT-MONOCLONAL ANTIBODY AND CULTURE METHODS.
International Centre for Diarrheal Disease Research, Dacca (Bangladesh).
A. Huq, R. R. Colwell, R. Rahman, A. Ali, and M. A. R. Chowdhury.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2370-2373, August 1990. 1 fig, 1 tab, 17 ref. A.I.D. Grant DPE-5542-G-55-4060-00, NSF Grant BSR-88-06509, EPA Agreement CR 81-2246-02-3.

Descriptors: *Human diseases, *Pathogenic bacteria, *Pollutant identification, *Vibrio, Analytical methods, Bangladesh, Culturing techniques, Fluorescent antibody technique, Plankton, Ponds, Public health, Rivers, Water quality monitoring.

Vibrio cholerae O1 is recognized as the etiological agent of pandemic Asiatic cholera. Vibrio cholerae O1 in plankton samples collected from ponds and rivers between February 1987 and January 1990 in Matlab, Bangladesh, was detected by the fluorescent-monoclonal antibody (FA) technique. Samples were collected at sites which were monitored fortnightly (fixed sites) as well as at sites that were part of a case-control study. FA results were compared with those obtained by conventional culture methods (CM). A total of 876 samples were collected; V. cholerae O1 was detected in 563 samples (64.3%) by the FA method and in 3 samples (0.34%) by CM. Of the fixed-site plankton samples, 439 (63.6%) were positive by FA and none were positive by CM. Of the 93 case sites sampled on the day after the occurrence of a case of cholera, 73 (78.5%) were positive for V. cholerae O1 by FA and 3 (3.2%) were positive by CM. In comparison, of the 93 first-day sample collections at control sites at the time a case of cholera occurred, only 51 (54.8%) were positive by FA and none were positive by CM. From the data, it is concluded that V. cholerae O1 is present throughout the year in the ponds and rivers of Bangladesh that were examined in this study and that V. cholerae can be detected by FA but not always by CM. The FA procedure was found to be very useful in detecting V. cholerae in plankton, with which it was associated and often occurred in large numbers in the nonculturable stage. Thus, studies investigating the significance of the role of environmental factors in the epidemiology of cholera can be performed effectively by using FA. (Author's abstract)
W91-00828

USE OF MEMBRANE EXTRACTION DISKS FOR ON-LINE TRACE ENRICHMENT OF ORGANIC COMPOUNDS FROM AQUEOUS SAMPLES.
Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry.
E. R. Brouwer, H. Lingeman, and U. A. T. Brinkman.
Chromatographia CHRGB7, Vol. 29, No. 9/1, p 415-418, May 1990. 3 fig, 1 tab, 8 ref.

Descriptors: *Analytical techniques, *Herbicides, *Organic compounds, *Pollutant identification, *Water analysis, Atrazine, Chromatography, Detection limits, Liquid chromatography, Membrane extraction disks, Pesticides, Preconcentration, Simazine, Trace levels, Trichlorophenol.

Membrane extraction disks have been recently introduced for the solid-phase extraction of organic compounds from aqueous samples. The material consists of alkyl-modified silica particles enmeshed in an inert PTFE matrix. Aqueous samples containing polar pesticides and herbicides are preconcentrated on-line from acidic solutions on membrane extraction disks containing immobilized octadecyl-modified silica and analyzed with an isocratic liquid chromatography system using PLRP-S as the stationary phase and aqueous acetonitrile mixtures (pH 3) as the eluant. The recoveries for atrazine, simazine, and 2,3,4-trichlorophenol from tap water at the 50 ppb level were 84, 81, and 89%, respectively. The calibration curves for the three components were linear over at least two orders of magnitude (1 to 100 ppb). For 10 ml samples, the detection limits of the analytes atrazine, simazine, and 2,3,4-trichlorophenol in tap water are 0.1-1.0 ppb. (Author's abstract)
W91-00839

MICROBIOLOGICAL INVESTIGATIONS INTO AN OUTBREAK OF PONTIAC FEVER DUE TO LEGIONELLA MICDADEI ASSOCIATED WITH USE OF A WHIRLPOOL.
Department of Laboratory Medicine, Ruchill Hospital, Glascow G20 9NB.
R. J. Fallon, and T. J. Rowbotham.
Journal of Clinical Pathology JCPAAK, Vol. 43, No. 6, p 479-483, 1990. 2 tab, 18 ref.

Descriptors: *Culturing techniques, *Legionella, *Microbiological studies, *Pollutant identification, Amebas, Epidemiology, Human diseases, Immunofluorescence, Lochgoilhead, Recreation facilities, Scotland, Water pollution, Whirlpool baths.

In the investigation of a large outbreak of nonpneumonic legionellosis at a leisure complex in Lochgoilhead, Scotland, all direct cultures of environmental samples were initially negative for legionellae. Legionellae readily infect appropriate protozoa under suitable conditions, and following immunofluorescence to select specimens for special study, Legionella micdadei was isolated from whirlpool water via co-cultivation with Acanthameba polyphaga. L. micdadei was also isolated, along with host amoebae, from the whirlpool filter. The use of amebas in the isolation of legionellae from environmental (and other) sources can be of great value, especially if specimens shown by indirect immunofluorescence to contain legionellae fail to yield legionellae on routine culture. (Author's abstract)
W91-00840

CHEMICAL CHARACTERIZATION OF ACID PRECIPITATION IN ALBANY, NEW YORK.
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
H. A. Khwaja, and L. Husain.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1869-1882, July 1990. 9 fig, 8 tab, 53 ref.

Descriptors: *Acid rain, *Air pollution, *Air pollution sources, *Chemical composition, *Chemistry of precipitation, *Hydrogen ion concentration, *Path of pollutants, *Sulfates, Ammonium, Calcium, Chemical analysis, Chlorides, Deposition, Magnesium, Nitrites, Precipitation, Seasonal variation, Sodium.

The chemical composition of precipitation in Albany, NY from July 1986 to December 1988 has been studied. Mean volume-weighted concentrations (microequivalents/liter) were: acidity, 104.0; alkalinity, -63.7; SO4(2-), 52.8; NO3(-), 29.8; Cl(-), 5.6; F(-),0.50; NH4(+), 19.3; Ca(2+), 6.5; Mg(2+), 2.8; Na(+), 3.5; and K(+), 1.4. Mean pH was 4.2. Seasonal patterns were pronounced for most species. Concentrations of H(+), SO4(2-), NO3(-), NH4(+) and Ca (2+) peaked in the summer and spring. Deposition was related to rainfall amount by a power law relationship in which the exponent of the equation was approximately 0.6. Wet SO4(2-) deposition was 2.35 kiloequivalents/hectare over a 30-month period. The SO4(2-) and NO3(-) deposition rates observed at Albany indicate that transport from midwestern sources have a major influence at this site. On the average, free H(+) ion concentrations determined the pH measurements accounted for 51% of the measured total acidity. There were unknown species, most likely organic acids, that could contribute to the acidity. Correlation and regression analysis revealed four common factors which are related to fossil-fuel combustion, sea spray, cement factory and biomass burning. (Author's abstract)
W91-00850

TRACE METAL WET DEPOSITION IN SWEDEN: INSIGHT GAINED FROM DAILY WET ONLY COLLECTION.
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
For primary bibliographic entry see Field 5B.
W91-00853

RELEASE OF HEAVY METALS FROM SNOWPACKS ON THE JAPAN SEA SIDE OF JAPAN.
Kanazawa Univ. (Japan). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W91-00858

FURTHER DISCUSSION ON THE INTERCOMPARISON OF THE TRACE METAL CONCENTRATIONS AND PARTICLE SIZE OF FLUVIAL SEDIMENT RECOVERED FROM TWO CENTRIFUGE SYSTEMS.
Geneva Univ. (Switzerland). Inst. F.-A. Forel.
S. Santiago, R. L. Thomas, J. L. Loizeau, P. Y. Favarger, and J. P. Vernet.
Hydrological Processes HYPRE3, Vol. 4, No. 3, p 283-287, July/September 1990. 1 fig, 2 tab, 5 ref.

Descriptors: *Analytical methods, *Analytical techniques, *Centrifugation, *Data acquisition, *Pollutant identification, *Trace metals, Barium, Beryllium, Boron, Calcium, Chromium, Cobalt, Copper, Heavy metals, Iron, Lead, Magnesium, Manganese, Nickel, Phosphorus, Sediment recovery, Sodium, Strontium, Switzerland, Vanadium, Zinc.

A single large volume water sample taken at the mouth of the Upper Rhone River on Lake Geneva was processed directly in parallel through two continuous flow centrifuges, a Westphalia and an Alfa-Laval. Sediment was recovered from the Westphalia, and separately from the bowl and brass core of the Alfa-Laval. The three sediment samples were analyzed for particle size and the following elements: Zn, Cu, Mn, Cr, P, Co, B, V, Be, Sr, Na, Pb, Ni, Ba, Fe, Ca, and Mg. Results indicate that the particle size recovery of both machines is similar when sediment from the brass core and bowl of the Alfa-Laval are combined, and that the recovery for all elements other than Cu, V, B, and Pb are the same when the particle size differences are taken into account. Sediment from the Alfa-Laval brass core is clearly contaminated by Cu and B and is also elevated in V and Pb but not to a significant extent. The sediment recovered from the bowl of the Alfa-Laval is contaminated only with Cu, with a 10 ppm increase over the 52 ppm recovered in the Westphalia sediment. Operating procedures involve the discarding of the brass core sediment and the mixing of the Alfa-Laval bowl sediment with that form the Westphalia. The consequent increase in Cu is estimated at less than 5 ppm or within the confidence level of the analysis. These procedures are recommended to all operators of non-modified Alfa-Laval units. (Author's abstract)
W91-00866

F-SPECIFIC RNA BACTERIOPHAGES AND SENSITIVE HOST STRAINS IN FAECES AND WASTEWATER OF HUMAN AND ANIMAL ORIGIN.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
A. H. Havelaar, W. M. Pot-Hogeboom, K. Furuse, R. Pot, and M. P. Hormann.
Journal of Applied Bacteriology JABAA4, Vol. 69, No. 1, p 30-37, July 1990. 1 fig, 5 tab, 15 ref.

Descriptors: *Bacteriophage, *Bioindicators, *Escherichia coli, *Feces, *Pollutant identification, *Wastewater, *Wastewater pollution, *Water pollution sources, Antibiotics, Barn wastes, Cattle, Fecal coliforms, Human pathogens, Laboratory methods, Municipal wastewater.

Bacteriophages are potential model viruses in water quality studies. Feces of humans, pigs, cattle and chickens were investigated for the presence of somatic coliphages. F-specific bacteriophages and Escherichia coli strains sensitive to infection by F-specific phages. Attention was given to the possible effect of age and use of antibiotics on the prevalence of the FRNA phages and sensitive E. coli strains. Somatic coliphages were often detected in high numbers in all types of feces. In contrast FRNA phages were rarely detected in feces from humans and cattle but more often in feces from pigs and adult chickens. Samples from young chickens (with or without antibiotics)were consistently positive for FRNA phages (up to 3 million plaque forming units (pfu)/g). F-specific RNA phages were found in substantial numbers (> 1000 pfu/ml) in a variety of wastewaters: domestic, hospital, slaughterhouses and occasionally in 'grey water'. Their origin in wastewater was not clear. Strains from feces usually belonged to serogroups I and IV. These types were also found in wastewater, as were group II and III strains. Serogroup II phages were abundant in wastewater of human origin but rare in feces. E. coli strains sensitive to infection by F-specific phages were common in feces (overall 290/1081: 27%). No strains with fully derepressed F-pilus synthesis were detected among the sensitive strains. It is concluded that the occurrence of F-specific RNA bacteriophages in water points to sewage pollution rather than fecal pollution; the mechanism of replication of these organisms in wastewater is not understood. (Author's abstract)
W91-00872

SAMPLING AND MONITORING OF REMEDIAL-ACTION SITES.
Weston (Roy F.), Inc., West Chester, PA.
T. P. McVeigh.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 12.2-12.34, 8 fig, 6 tab.

Descriptors: *Hazardous waste disposal, *Monitoring, *Sampling, *Site remediation, *Waste disposal, Assessments, Data collections, Data management, On-site investigations.

Sampling and monitoring at remedial-action sites are part of the Remedial Investigation and Feasibility Study process described in the National Oil and Hazardous Substance Contingency Plan. Data collection and site characterization are the primary elements of the remedial investigation. Additional activities are the primary elements of the remedial investigation. Additional activities include data management, bench and/or pilot studies, and site-investigation reports. Prior to any sampling or monitoring activities at a remedial-action site, a preliminary assessment is performed. The assessment usually consists of the following four elements: collection of existing data, identification of site characteristics and pollutant pathways, evaluation of potential hazards, and identification of data requirements for site assessment and remedial

action. The information from these activities will be used in the development of the sampling, health and safety, and quality-assurance plans for the site. Sampling at remedial-action sites requires the development of three plans before the actual site activities begin: sampling, health and safety, and quality-assurance plans. The sampling program begins with the monitoring of ambient conditions during the preliminary site assessment and ends with the validation of analytical data by the laboratory. Sampling is conducted to determine hazardous-waste sources, and to monitor soils and sediments, groundwater, surface waters, and air quality. Two procedures are recommended to accomplish effective management of environmental-monitoring data: institution of a document-control system for files and reports, and the use of automated data processing for analytical data. Remedial actions are then designed to control, contain, treat or remove contaminants from uncontrolled hazardous-waste sites. Remedial actions are divided into surface controls, groundwater controls, leachate controls, direct-treatment methods, gas-migration controls, techniques for contaminated water and sewer line, and methods for contaminated-sediment removal. (See also W91-00900) (White-Reimer-PTT)
W91-00955

SAMPLING AND ANALYSIS OF HAZARDOUS WASTES.
Environmental Monitoring Systems Lab., Research Triangle Park, NC.
L. D. Johnson, and R. H. James.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 13.3-13.44, 10 fig, 12 tab, 47 ref.

Descriptors: *Chemical analysis, *Hazardous materials, *Hazardous wastes, *Sampling, *Testing procedures, Analytical techniques, Documentation, Quality control, Regulations, Sample analysis.

An overview and guide to the field of sampling and analysis of hazardous waste and related products is presented. Topics covered include techniques for: (1) sampling hazardous waste; (2) sampling waste-combustion products; (3) sampling solid and liquid effluents from combustors and control devices; (4) sample containers, shipping, and storage; (5) quality control and quality assurance; and (6) safety. Methods of measuring and defining toxic and hazardous emissions in the environment have been developed. For most samples, the analyst should employ proven analytical techniques that are selective and sensitive. The most universal methods for trace analysis are gas chromatography, liquid chromatography, mass spectrometry, and a combination of these techniques. The integrity of the analytical data is highly dependent on the sample submitted for instrumental analysis. While most instrumental 'finishes' yield final data that are of known quality when standard solutions are analyzed, many areas of sample handling prior to analysis are more variable and matrix-dependent and are critical to the accuracy of the resulting data. Test procedures, or supporting documentation, for the analysis of hazardous wastes is required in each of four major areas: waste characteristics, proximate analyses, survey analyses, and directed analysis. Analytical measurements should be documented to provide easy access to information that will support all claims for the results. Laboratory records should be retained in a permanent file for a length of time set by the government or necessary to fulfill other legal requirements. Quality assurance is the highest priority with respect to the analysis of environmental samples. Therefore the quality assurance program must contain procedures that cover program management and personnel responsibilities, facilities and equipment, data generation and processing, data-quality assessment, and corrective actions. (See also W91-00900) (White-Reimer-PTT)
W91-00958

5B. Sources Of Pollution

EMPIRICAL MODELS FOR PREDICTING WATER QUALITY, AS APPLIED TO DATA ON LAKES OF POLAND.
Polish Academy of Sciences, Warsaw. Zaklad Paleobiologii.
For primary bibliographic entry see Field 2H.
W91-00001

NUMERICAL MODEL OF PHOSPHORUS EXCHANGE BETWEEN THE SEDIMENTS AND THE NEAR-BOTTOM WATER IN A LAKE.
Warsaw Univ. (Poland). Lab. of Medical Physics.
For primary bibliographic entry see Field 2H.
W91-00002

METHODS FOR IMPROVING THE EFFICIENCY OF CALIBRATION OF A MODEL OF PHOSPHORUS CYCLING IN A LAKE ECOSYSTEM.
Politechnika Warszawska (Poland). Inst. of Environmental Engineering.
For primary bibliographic entry see Field 2H.
W91-00004

GEOCHEMICAL STUDY OF SEDIMENT CONTAMINATION IN NEW BEDFORD HARBOR, MASSACHUSETTS.
Environmental Protection Agency, Narragansett, RI. Environmental Research Lab.
R. J. Pruell, C. B. Norwood, R. D. Brown, W. S. Boothman, and P. F. Rogerson.
Marine Environmental Research MERSDW, Vol. 29, No. 2, p 77-101, 1990. 4 fig, 6 tab, 43 ref.

Descriptors: *Estuarine sediments, *Geochemistry, *Industrial wastes, *Marine pollution, *Massachusetts, *Path of pollutants, *Polychlorinated biphenyls, *Sediment contamination, *Water pollution sources, Chemical analysis, Combined sewer overflows, Environmental gradient, Sludge disposal, Trace metals, Urban runoff.

Chemical analyses of sediment samples collected along a transect in New Bedford Harbor revealed a gradient of increasing concentrations of polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polycyclic aromatic hydrocarbons (PAHs) and several trace metals from the southern to the northern areas of the estuary. Although the concentrations of contaminants generally increased with distance north in the estuary for all classes of compounds, differences were observed between the trends for many of the compounds. These differences are probably due to both the sources and differential environmental behaviors of the compounds in the estuary. The primary sources of PCBs, PCDFs, and trace metals appear to be industrial discharges either directly into the estuary or through combined sewer overflows. Additional inputs of PCDFs may have also impacted the lower portions of the harbor. These inputs may be from the combustion of sewage sludge containing high concentrations of PCBs at the New Bedford Harbor Municipal Wastewater Treatment Plant. The major inputs of PAHs and PCDDs are probably from urban runoff entering the harbor through combined sewer overflows and storm drains. (Stoehr-PTT)
W91-00043

EFFECTS OF DRILL CUTTINGS ON A MODEL MARINE SEDIMENT SYSTEM.
Heinz and Co. Ltd., Hayes (England). Microbiology Dept.
For primary bibliographic entry see Field 5C.
W91-00044

CASCADING WATER: A THREAT TO GROUND WATER QUALITY.
G. L. Hix.
Water Well Journal WWJOA9, Vol. 44, No. 4, p 40-41, April 1990.

Descriptors: *Cascading water, *Groundwater pollution, *Groundwater quality, *Water pollution sources, *Well casings, *Well seepage, Groundwater recharge, Grouting, Perched water, Water table, Well water.

Cascading water or ground water that is entering some older water wells and flowing down into the well casing is a problem that concerns ground water quality regulators, well owners, and drillers wherever it occurs. Often, this cascading water is of lesser quality than that present in the lower part of the well. How much poorer the quality of this returning water depends on the source of that water and the type of contamination it carries with it. Water quality deterioration is a primary concern but deterioration of the well itself is also a problem. One method to solve this water problem is to cut off the source of the recharge water. If this is impractical, it is sometimes possible to intercept this water with new wells or by installing cut-off walls made of bentonite slurry or other grout materials. Sometimes the well itself can be modified to shut out the water, but this does not entirely solve the problem. The return water is now just perched outside the well where it will eventually find its way to the water table. Attempts have been made to inject grout outward through the well casing perforations using inflatable packers to seal off part of the well. This method works only if the grout doesn't find channels outside the well casing that short circuit and divert it back inside the well above or below the packers. Another method tried is to line the well with a smaller diameter casing and grouting the annular space. Again, this procedure seals out the water and prevents it from entering the well. It will not remove the perched water nor solve the problem completely. Eliminating cascading water altogether may not be possible in most areas, but controlling the extent of the damage to wells, pumps, and groundwater quality is. (Medina-PTT)
W91-00053

THREE-DIMENSIONAL SCALE MODEL OF GROUND-WATER SOLUTE TRANSPORT.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Div. of Engineering Fundamentals.
S. S. Crider, B. L. Sill, and D. E. Gordon.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 816-834, June 1990. 14 fig, 4 tab, 23 ref. Department of Energy Contract No. DE-AC09-76Sr00001.

Descriptors: *Hydraulic models, *Hydrologic models, *Model studies, *Path of pollutants, *Solute transport, Groundwater movement, Groundwater pollution, Savannah River Plant, South Carolina, Waste disposal.

A three-dimensional scale model was designed and built to simulate groundwater solute transport at the Savannah River Site in east-central South Carolina. The site is 0.75 sq km in surface area, and averages 35 m in depth. Liquid wastes have been continuously disposed of on the site for about 30 yr. The model was built to an undistorted geometric length scale of 1/500. Model materials of sand, cement, and water, blended in varying proportions to achieve different hydraulic conductivities and effective porosities, allowed simulation of four geologic formations in the prototype. The organic dye Rhodamine 6G was used to represent the prototype solute, tritium. Using scaling laws developed for advection, dispersion, chemical interaction, and making adjustments for the radioactive decay of the tritium, the model plume favorably compared with the carefully mapped plume at the prototype. Capillary forces were not scaled. The model included more than 125 simulated wells in two formations. A peristaltic pump was used to discharge source dye into the model, a fluorometer was used to measure fluorescence of the dye, and the concentration of dye (solute) was calculated. The concentrations were modified to account for the radioactive decay of the solute (tritium), and the data used to plot isoconcentration lines. Comparison of model predictions to prototype benchmarks are generally favorable; some problems are attributable to the inability of the model to simulate flow through the unsaturated zone. More

widespread use of scale models in groundwater research is cautiously recommended. (Author's abstract)
W91-00064

LONGITUDINAL AND SEASONAL WATER CHEMISTRY VARIATIONS IN A NORTHERN APPALACHIAN STREAM.
Marian Coll., Indianapolis, IN. Dept. of Biology.
For primary bibliographic entry see Field 2K.
W91-00089

THEORY OF SUBSURFACE WATER-BORNE SOLUTE TRANSPORT.
Australian Nuclear Science and Technology Organisation, Sutherland. Environmental Science Div.
G. Pantelis.
Advances in Water Resources AWREDI, Vol. 13, No. 1, p 24-28, March 1990. 9 ref, append.

Descriptors: *Advection, *Convection, *Dispersion, *Groundwater movement, *Mathematical models, *Model studies, *Path of pollutants, *Saturated flow, *Unsaturated flow, Groundwater, Mathematical equations, Parabolic equations, Soil water, Specific discharge.

The many computer codes currently available for simulating subsurface waterborne pollutant transport are usually based on some finite difference or finite element approximation of the equations which describe the transport mechanisms at the representative elementary volume (REV) level. When the transport equations at the REV level are applied to spatial and time scales which differ greatly from those associated with the REV, some averaging or asymptotic procedure may be necessary to reveal a new set of properties for the mathematical formulation. The equations for the water mass balance and the waterborne solute transport in a regional unconfined aquifer are used to determine a three-dimensional specific discharge field. The aquifer is treated as a coupled saturated-unsaturated system with a time varying water table height. The REV-level approach results in excessive computations and numerical inaccuracies at the regional scale, and modifications based upon scale are required. The associated convection-dispersion equation indicates that vertical advection must be included although it is numerically much smaller than the horizontal advection on the local scale. On the regional scale transverse dispersion is dominant in regions of high moisture content, whereas longitudinal dispersion is negligible everywhere. The asymptotic theory presented indicates that if longitudinal dispersion is to be a meaningful quantity in regional aquifer simulations it is necessary to have a high degree of accuracy in the water matric pressure head and specific discharge. (Tappert-PTT)
W91-00119

NUMERICAL MODEL FOR AREAL MIGRATION OF WATER AND LIGHT HYDROCARBON IN UNCONFINED AQUIFERS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
J. J. Kaluarachchi, J. C. Parker, and R. J. Lenhard.
Advances in Water Resources AWREDI, Vol. 13, No. 1, p 29-40, March 1990. 16 fig, 1 tab, 24 ref. American Petroleum Institute Modeling Task Force Contract WM-5-324-7.

Descriptors: *Finite element method, *Hydrocarbons, *Mathematical models, *Model studies, *Multiphase flow, *Path of pollutants, Galerkin method, Mass balance, Mathematical analysis, Mathematical equations, Numerical analysis, Recovery wells, Seepage, Spills, Unconfined aquifers.

A finite element model has been developed to simulate the simultaneous flow of water and light hydrocarbons in an unconfined aquifer, for analysis of hydrocarbons spreading from subsurface leaks or spills and for use in the design of free product recovery systems. Vertically integrated governing equations for water and oil flow are employed which assume local vertical equilibrium and negligible gas pressure gradients. Multiple water and free product recovery wells are handled as internal type-1 boundary conditions by stipulating air-oil table elevation and free product height, with corrections to convert grid averaged nodal heads to actual well bore fluid levels. An automatic updating scheme for well bore correction factors is introduced which ensures consistency of well flux calculations with the global mass balance. Areal model predictions are compared with two dimensional vertical cartesian and radial simulations, with multiphase seepage faces for hypothetical trench and well free product recovery systems. The results indicate that the assumption of vertical equilibrium and lack of explicit treatment of seepage faces in the areal model produce minor loss in accuracy while conferring a major reduction in computational effort. Simulations of various spill spreading and free product recovery scenarios with multiple pumping wells are investigated to demonstrate the model capabilities. (Author's abstract)
W91-00120

TIME SERIES ANALYSIS OF UNEQUALLY SPACED OBSERVATIONS-WITH APPLICATIONS TO COPPER CONTAMINATION OF THE RIVER GAULA IN CENTRAL NORWAY.
Norsk Regnesentral, Oslo.
M. Aldrin, E. Damsleth, and H. V. Saebo.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 227-243, November 1989. 8 fig, 4 tab, 7 ref.

Descriptors: *Copper, *Gaula River, *Monitoring, *Norway, *Path of pollutants, *Time series analysis, *Water pollution sources, Data interpretation, Mathematical analysis, Sampling, Statistical analysis, Statistics.

The upper reaches of the Gaula River in central Norway are heavily contaminated by toxic metals, particularly copper, due to mines located along the headwaters. A monitoring program for the river was established in early 1986, and the concentration of Cu, among other variables, has been measured. Goals of the investigation included: (1) to estimate the various statistical characteristics for concentrations and loadings of heavy metals along the river; and (2) to quantify the effect of the contamination from the copper mines both locally and further downstream. There was a fairly strong temporal component in the Cu measurements, which called for a time series model. The irregular pattern of the observation times, however, made the usual models infeasible as they assumed equispaced observations. A simple dynamic linear model (DLM) was used which gave a satisfactory description of the Cu concentration series. The model was fitted to the data using a Kalman filter technique, which handled the irregularly spaced observations without problems. The model has been utilized to: interpolate non-observed values; estimate the net loading; and simulate alternative patterns for the Cu series (observed values and the runoff) in order to obtain estimates of the extreme values and the probability that the concentration has exceeded a certain limit. (Author's abstract)
W91-00128

EVALUATION OF PHOSPHORUS LOADS FROM ONTARIO MUNICIPAL WASTEWATER TREATMENT PLANTS.
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
For primary bibliographic entry see Field 5D.
W91-00132

STATUS OF THE NIAGARA RIVER POINT SOURCE DISCHARGE INFORMATION: SAMPLING DESIGN AND ESTIMATION OF LOADING.
National Water Research Inst., Burlington (Ontario).
A. H. El-Shaarawi, and D. J. Williams.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 331-341, November 1989. 6 tab, 4 ref.

Descriptors: *Industrial wastewater, *Monitoring, *Niagara River, *Pollution load, *Sampling, *Statistical analysis, *Statistical methods, Canada, Mathematical studies, Path of pollutants, Wastewater analysis, Wastewater pollution.

Toxic pollutants are discharged to the Niagara River from a number of municipal and industrial point sources. A reliable estimate of the load must satisfy several requirements, including the absence of systematic error (bias), a high level of precision, and some estimate of the uncertainty surrounding the load estimate generated from the data. Both bias and low precision can result from using a bad sampling design and/or an inadequate method of estimation. The effects of biases can be reduced at the design stage prior to data collection or at the data analysis stage. From a management perspective, compliance cannot be effectively monitored if sources of bias in the data are not removed. An evaluation of recently published point source discharge data from the Niagara River suggests that mean values based upon single point in time sampling are not comparable with median values based upon monthly facility data, and that monthly facility data tend to underestimate the actual load. The application of matrix techniques such as the Balanced Incomplete Block Design to develop sampling plans can be useful in allocating restricted resources to provide the best estimate of pollutant load. (Tappert-PTT)
W91-00134

INFERENCES ABOUT POINT SOURCE LOADING FROM UPSTREAM/DOWNSTREAM RIVER MONITORING DATA.
International Joint Commission-United States and Canada, Windsor (Ontario).
D. M. Dolan, and A. H. El-Shaarawi.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 343-357, November 1989. 5 fig, 11 tab, 12 ref.

Descriptors: *Industrial wastewater, *Monitoring, *Path of pollutants, *Pollution load, *Statistical analysis, *Water pollution sources, *Water quality, Canada, Sampling, Statistical methods, Wastewater pollution, Water quality management.

Active sources of contaminants in the Great Lakes are primary targets for remedial actions by water quality managers. Most Areas of Concern in the Great Lakes Region such as the Niagara and Detroit Rivers contain a myriad of point and non-point sources. These are difficult and expensive to monitor and often present unique analytical problems subject to analytical error. The Niagara River Toxics Committee and the Upper Great Lakes Connecting Channels Study Modeling Committee designed programs to indirectly monitor these sources by upstream/downstream sampling at the head and mouth of the rivers. Paired samples are collected by staggering the time of collection based upon travel time of the receiving water. Objectives of the monitoring were to determine trends in contaminant concentrations over time, compare concentrations to criteria and report exceedences, and estimate relative differences between the head and mouth of the river. Upstream/downstream samples were paired to obtain differential loadings wherever possible, but when some results were reported as below the detection limit, a maximum likelihood estimate was used. The resulting differential loading, adjusted for non-point sources, is the total point source load to the river minus any losses due to volatilization, settling or degradation. (Tappert-PTT)
W91-00135

STATISTICAL ZONATION OF SEDIMENT SAMPLES USING RATIO MATCHING AND CLUSTER ANALYSIS.
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
For primary bibliographic entry see Field 2J.
W91-00137

ROBUST GRAPHICAL METHODS FOR DIAGNOSING TREND IN IRREGULARLY SPACED WATER QUALITY TIME SERIES.
Ontario Ministry of the Environment, Toronto.

Water Resources Branch.
B. A. Bodo.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 407-428, November 1989. 7 fig, 31 ref.

Descriptors: *Data interpretation, *Graphical analysis, *Graphical methods, *Time series analysis, *Water quality, *Water quality trends, Forecasting, Mathematical analysis, Monitoring, Regression analysis, Water pollution sources.

Although point source pollution monitoring may be concerned with directly characterizing the properties of an effluent stream, it is frequently necessary to assess the impacts of point sources in receptor media. Graphical methods can enhance reliability in the assessment of data from river quality data series, both as diagnostic tools and as visual corroborative evidence when assumptions required for formal statistical tests are not met. Robust, graphically oriented trend diagnostic procedures can be applied to data series characterized by nonnormal populations, uneven time spacing, nonmonotonic trends and other factors which can create serious problems for standard parametric time series methods. Cleveland's robust locally weighted regression (RLWR) developed for investigating nonlinearity in x-y scatterplots was adapted as a robust/resistant smoothing filter for the analysis of irregular time series of quantitative observations. Low powered RLWR trend lines revealed temporally local phenomena, such as abrupt jumps (often associated with point source impacts) and periodicities, while higher powered RLWR yielded smooth lines characterizing medium and longer term trends. Simple variants of Tukey smoothing concepts were developed for series with censored observations. Applications to Ontario river quality series reveal that graphical evidence is frequently sufficient to obviate the need for formal trend testing. The methods are generally applicable to most time series. (Tappert-PTT)
W91-00138

DEVELOPMENT OF A SOFTWARE PACKAGE FOR TREND DETECTION IN TEMPORAL SERIES: APPLICATION TO WATER AND INDUSTRIAL EFFLUENT QUALITY DATA FOR THE ST. LAWRENCE RIVER.
INRS-Eau, Sainte-Foy (Quebec).
D. Cluis, C. Langlois, R. van Coillie, and C. Laberge.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 429-441, November 1989. 4 fig, 6 tab, 16 ref.

Descriptors: *Computer models, *Computer programs, *Evaluation, *Monitoring, *Statistical analysis, *Water quality, Fortran, Industrial wastewater, Markov process, Pollution load, Statistical methods, Water analysis, Water quality management, Water sampling.

Follow-up environmental studies are an essential step in the objective assessment of the efficiency of any sanitation program. Despite the considerable amount of effort and resources involved in monitoring water quality, water quality assessment and environmental follow-up are sometimes carried out with simple statistics, the main reason being the lack of appropriate statistical methods adapted to the nature of sampled water quality data. A survey of the classical methods used for trend detection, including the most recent non-parametric techniques, reveal many problems with statistical analysis due to the structure of the sampled data and the possible types of trends occurring. Water quality data are rarely normally distributed or temporally independent. The sampling frequency, widely asymmetric distributions, seasonal variances, and characteristics of data reporting (such as detection limits) reduce the effectiveness of standard techniques for trend detection. A new set of nonparametric tests now exist that are better suited to the real structure of water quality data. Coupled with retrospective graphical techniques as preliminary analytical tools, an interactive user-friendly software package written in Fortran has been developed for microcomputers making use of these latest adapted techniques. The software was applied to phenol loadings discharged from two Montreal refineries, and dissolved nitrogen concentrations in the St. Lawrence River. The software should be updated as improved trend detection techniques appear in the literature. (Tappert-PTT)
W91-00139

CRUDE OIL AND HYDROCARBON-DEGRADING STRAINS OF RHODOCOCCUS RHODOCHROUS ISOLATED FROM SOIL AND MARINE ENVIRONMENTS IN KUWAIT.
Kuwait Univ., Safat. Dept. of Botany and Microbiology.
N. A. Sorkhoh, M. A. Ghannoum, A. S. Ibrahim, R. J. Stretton, and S. S. Radwan.
Environmental Pollution ENPOEK, Vol. 65, No. 1, p 1-17, 1990. 5 fig, 5 tab, 26 ref. Kuwait University, Research Council, grant no. S0033; Kuwait Foundation for the Advancement of Science, grant no. 87-01-04.

Descriptors: *Biodegradation, *Environmental engineering, *Fate of pollutants, *Hydrocarbons, *Kuwait, *Marine bacteria, *Oil pollution, *Soil bacteria, Biological treatment, Environmental effects, Fungi, Marine environment, Marine pollution, Oil industry.

The oil industry and various related processes pose a constant threat to the marine environment as a consequence of the huge influx of petroleum hydrocarbons into this ecosystem. The northwestern region of the oil-producing Persian Gulf is heavily polluted. Soil and marine samples collected from different localities in Kuwait were screened for microorganisms capable of oil degradation. Both fungi and bacteria were isolated. The fungal flora consisted of Aspergillus terreus, A. sulphureus, Mucor globosus, Fusarium sp. and Penicillium citrinum. Mucor globosus was the most active oil degrading fungus isolated. Bacterial isolates included Bacillus spp., Enterobacteriaceae, Pseudomonas spp., Nocardia spp., Streptomyces spp., and Rhodococcus spp. Among these, Rhodococcus strains were the most efficient in oil degradation and, relatively, the most abundant. Bacterial and fungal isolates differed in their ability to degrade crude oil, with Rhodococcus isolates being more active than fungi in n-alkane biodegradation, particularly in the case of R. rhodochrous. In addition to medium chain n-alkanes, fungi utilized one or more of the aromatic hydrocarbons studied, while the bacteria failed to do so. R. rhodochrous KUCC 8801 was shown by gas liquid chromatography and post-growth studies to be more efficient in oil degradation than isolates known to be active oil degraders. (Author's abstract)
W91-00144

ACID PRECURSOR CONCENTRATIONS ABOVE THE NORTHEASTERN UNITED STATES DURING SUMMER 1987: THREE CASE STUDIES.
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
J. F. Boatman, N. Laulainen, J. Ray, C. Van Valin, and L. Gunter.
Journal of Geophysical Research (D) Atmospheres JGRDE3, Vol. 95, No. 8, p 11,831-11,845, July 20, 1990. 10 fig, 2 tab, 40 ref.

Descriptors: *Acid rain, *Air pollution, *Atmospheric chemistry, *Path of pollutants, *Trace levels, *Water pollution sources, Aircraft, Data collections, Hydrogen peroxide, Nitrogen oxides, Ozone, Sulfur dioxide.

Two aircraft measured the spatial distribution of selected acid trace species (SO2, H2O2, O3, and NOy) above the northeastern United States during summer. The aircraft flew together on three missions between Columbus, Ohio and Saranac Lake, New York. The sulfur dioxide concentration averaged 1-2 ppbv within the planetary boundary layer (pbl) and <1 ppbv in the free troposphere. Superimposed on this background concentration were surface source regions with elevated concentrations as high as 14 ppbv. The hydrogen peroxide concentration averaged 2-4 ppbv, with the highest values found above the top of the pbl. The H2O2 pattern increased in both size and intensity above the top of the pbl during the afternoon, possibly due to photochemical production and advection. The ozone concentration varied between 30 and 110 ppbv. The concentration of O3 increased by as much as 30 ppbv during the day. Nitrogen oxide concentrations were in the range <1-8 ppbv. The pattern of SO2 and NO concentrations remained substantially the same during the daytime hours. The O3 and NOy concentrations were linked to surface emissions and photochemical processes. The ratio between H2O2 and SO2 was >1, except in the lower pbl and near surface SO2 source regions. It was found that it was feasible to collect pollutant data using multiple aircraft in repeated flights over long distances, and that this technique is in fact necessary to capture the vertical patterns of pollutants. (Fish-PTT)
W91-00148

USING ISOTOPE FRACTIONATION OF NITRATE-NITROGEN AND NITRATE-OXYGEN FOR EVALUATION OF MICROBIAL DENITRIFICATION IN A SANDY AQUIFER.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
J. Bottcher, O. Strebel, S. Voerkelius, and H. L. Schmidt.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 413-424, May 1990. 5 fig, 1 tab, 15 ref. Deutsche Forschungsgemeinschaft.

Descriptors: *Biotransformation, *Denitrification, *Fate of pollutants, *Isotope fractionation, *Isotope studies, *Nitrates, *Nonpoint pollution sources, *Oxygen isotopes, *Sand aquifers, Coniferous forests, Enrichment, Germany, Groundwater flow, Groundwater recharge, Land use, Monitoring wells, Water sampling.

The nitrate input into the groundwater from forest and agricultural land in the Fuhrberger Feld catchment area in West Germany is virtually completely degraded by microbial denitrification in the aquifer. Five multilevel groundwater sampling wells show characteristic depth functions of nitrate, proving the denitrification process. A series of 10 samples of 'arable land groundwater' was taken from different depths at these multilevel wells and isotope ratios of N15/N14 and O18/O16 in the nitrate were measured. The sampling was based on the two-dimensional vertical-plane groundwater flownet and on the knowledge of the land use upgradient of the multilevel wells. High nitrate concentrations are associated with low delta N15 and low delta O18 values, and vice versa. The delta N15/delta O18 ratio indicates a linear increase with a slope of 1:2.1. The microbial denitrification accords with a Rayleigh process with calculated enrichment factors of -15.9 ppt for N15 and -8.0 ppt for O18. Three samples taken from groundwater recharged under coniferous forest show deviating characteristics: low nitrate concentrations with low delta N15 values but very high delta O18 values. Using the enrichment factors for N15 and O18, an attempt was made to ascertain the significance of denitrification in specific depth sections at two other multilevel wells. In two cases quantitative assessments on the degree of nitrate concentration decrease owing to denitrification were possible. However, in other cases the specific nitrate isotope fractionation was masked by the variability of nitrate concentration and of nitrate isotope ratios in the corresponding groundwater recharge preventing definite interpretations. (Author's abstract)
W91-00166

INFLUENCE OF PH, TEMPERATURE AND SEDIMENT TYPE ON THE TOXICITY, ACCUMULATION AND DEGRADATION OF PARATHION IN AQUATIC SYSTEMS.
Ohio State Univ., Columbus. Dept. of Zoology.
M. J. Lydy, T. W. Lohner, and S. W. Fisher.
Aquatic Toxicology AQTODG, Vol. 17, No. 1, p 27-44, July 1990. 2 fig, 7 tab, 35 ref.

Descriptors: *Acute toxicity, *Fate of pollutants, *Midges, *Parathion, *Path of pollutants, *Water pollution effects, Animal metabolism, Bioavailability, Chemical degradation, Hydrogen ion concen-

tration, Insecticides, Laboratory methods, Sediments, Temperature effects.

Parathion is a widely-used insecticide which is believed not to persist in the environment. However, its detection in ground water supplies has raised doubt as to whether it is ephemeral. The effects of pH, temperature, and sediment on the toxicity and aquatic fate of parathion were investigated. Acute toxicity tests, accumulation and metabolism studies were conducted with midge larvae, Chironomus riparius, at pH values 4, 6, and 8 in water held at 10, 20, and 30 degrees, with and without sediment. Abiotic tests were also performed to determine the fate of parathion under various substrate conditions. Without exception, temperature was the most influential parameter tested. It altered both the toxicity and metabolism of parathion, at times increasing toxicity as much as 100-fold when the temperature increased from 10 C to 30 C. Sediment also influenced parathion toxicity and degradation, although to a lesser extent than temperature. Changes in pH had little influence on parathion toxicity or degradation. The results of these studies further emphasize the importance of abiotic factors on the environmental fate of xenobiotics. (Author's abstract)
W91-00193

BIOACCUMULATION OF KEPONE BY GRASS SHRIMP (PALAEMONETES PUGIO): IMPORTANCE OF DIETARY ACCUMULATION AND FOOD RATION.
Maryland Univ., Queenstown. Wye Research and Education Center.
D. J. Fisher, and J. R. Clark.
Aquatic Toxicology AQTODG, Vol. 17, No. 2, p 167-186, August 1990. 4 fig, 4 tab, 31 ref.

Descriptors: *Bioaccumulation, *Biological magnification, *Fate of pollutants, *Insecticides, *Organochlorine pesticides, *Path of pollutants, *Shrimp, Animal metabolism, Bioavailability, Estuarine environment, Feeding rates, Food chains.

The relative extent of Kepone chloralscone uptake from food (dietary accumulation) and water (bioconcentration) by grass shrimp (Palaemonetes pugio) was evaluated quantitatively at food rations of 4% and 8% of the average weight of the shrimp. C14-Kepone was utilized to determine bioconcentration and dietary accumulation separately, while C14-Kepone-contaminated food (grass shrimp) and unlabeled Kepone in water were used to determine accumulation from both sources simultaneously. Grass shrimp and their food were exposed to the same aqueous Kepone concentration (0.04 micrograms/L). A first-order pharmacokinetic equation was used to model Kepone accumulation kinetics during the 16-day uptake and 21-day clearance phases. A doubling of contaminated food ration caused a significant (alpha = 0.05) increase in the whole-body Kepone concentration in the shrimp. Shrimp fed either a 4% or 8% ration of uncontaminated food and exposed to 0.04 micrograms/L Kepone in water bioconcentrated Kepone equally. When shrimp were exposed to contaminated water and food, Kepone accumulation from each source was additive. Food ration, however, was very important in determining final Kepone body burdens. The dietary source of Kepone represented approximately 24% and 33% of the total body burden accumulated by shrimp fed 4% and 8% food rations, respectively, but assimilation efficiencies of Kepone from the food source were low. The laboratory results suggest that dietary accumulation of Kepone by grass shrimp may play an important role in determining final Kepone body burdens in feral organisms, especially during periods of high food consumption. (Author's abstract)
W91-00201

POTENTIAL FOR AGRICULTURAL PESTICIDE RUNOFF TO A PUGET SOUND ESTUARY: PADILLA BAY, WASHINGTON.
Western Washington Univ., Bellingham. Inst. for Watershed Studies.
J. R. Mayer, and N. R. Elkins.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 215-222, August 1990. fig 1, tab 2, 14 ref.

Descriptors: *Estuarine environment, *Nonpoint pollution sources, *Path of pollutants, *Pesticides, *Washington, Agricultural runoff, Chemical analysis, Estuarine sediments, Halogenated pesticides, Herbicides, Puget Sound, Sediment analysis, Sediment contamination.

Padilla Bay, an estuary of Puget Sound, possesses one of the three most extensive eelgrass communities in the Pacific Northwest. Recently, the potential for pesticide contamination of Padilla Bay has received attention due to the intensively managed agricultural areas immediately to the east of the Bay. The purposes of this 2 year investigation were: (1) to identify and quantify pesticide runoff in this agricultural environment; and, (2) to assess the ecological significance of pesticide runoff to Padilla Bay given the knowledge that fourteen pesticides are applied each summer at known rates. Four sampling expeditions were carried out; the first and third were during the springs of 1987 and 1988 and were before any pesticide applications for those years, while the second and fourth were during the summers of 1987 and 1988, after pesticide applications were completed. The results show that no ecologically significant levels of any of the fourteen pesticides studied were found in the water or sediments associated with Padilla Bay sloughs or the Bay itself during this investigation. The very low levels of dicamba and 2,4-D found in some water and sediment samples supports the view that they are subject to runoff following significant rain events. (Hoskin-PTT)
W91-00204

HEAVY METAL CONTAMINATION IN THE RIVER TOAD, BUFO JUXTASPER (INGER), NEAR A COPPER MINE IN EAST MALAYSIA.
National Univ. of Malaysia, Kota Kinabalu. Faculty of Science and Natural Resources.
Y. H. Lee, and R. B. Stuebing.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 272-279, August 1990. 1 fig, 3 ref, 14 ref.

Descriptors: *Bioindicators, *Heavy metals, *Malaysia, *Mine wastes, *Path of pollutants, *Toads, Bioaccumulation, Bioassay, Chromium, Cobalt, Copper, Embryonic growth stage, Lead, Liver, Manganese, Mine drainage, Regression analysis, Silver, Trace metals, Zinc.

An open pit copper mine situated in the Northwest of Sabah, East Malaysia has been known to pollute its surroundings, especially with discharges involving heavy metals. As amphibians live both on land and in water, a study on the heavy metal content of these animals will enable a more extensive evaluation of the degree of contamination by heavy metals. Toads (Bufo juxtasper) were collected from four different sites, with only one location directly affected by mine effluent discharge. The liver Cu content of toads collected from all sampling sites appears to be extremely variable and abnormally high (range: 4-1020 ppm). The Cd and Ni content of toad livers from the effluent-affected site were significantly higher compared to all three non-polluted sites. Cu content was also significantly greater for the polluted site compared to two of the control sites. Pb and Zn were significantly higher at the polluted site over one of the control sites. No significant difference was observed between the contents of Ag, Co, Cr and Mn in the liver of B. juxtasper collected from the polluted and control sites. There was a negative correlation between Pb content and liver size, indicating accumulation of Pb in the larval phase of B. juxtasper but such accumulation declined relative to body weight when the toad entered the adult phase. (Hoskin-PTT)
W91-00209

COMPARATIVE TOXICITY OF AN EFFLUENT FROM A CHLOR-ALKALI INDUSTRY AND HGCL2.
Berhampur Univ. (India). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W91-00210

BIOACCUMULATION OF MERCURY AND ITS EFFECT ON PROTEIN METABOLISM OF THE WATER HYACINTH WEEVIL NEOCHETINA EICHHORNAE (WARNER).
Indian Inst. of Chemical Technology, Hyderabad. Biology Group.
For primary bibliographic entry see Field 5C.
W91-00212

APPROPRIATE METHODOLOGIES FOR DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES IN DEVELOPING COUNTRIES. VOLUME I.
For primary bibliographic entry see Field 4B.
W91-00215

ENVIRONMENTAL ISOTOPE-AIDED STUDIES ON WATER RESOURCES IN THE REGION OF CHEJU ISLAND.
Korea Advanced Energy Research Inst., Daeduk (Republic of Korea).
For primary bibliographic entry see Field 2F.
W91-00224

ESTIMATION OF RECHARGE AND POLLUTANT TRANSFER TO GROUNDWATER BY MODELLING OF UNSATURATED ZONE.
Roorkee Univ. (India). School of Hydrology.
For primary bibliographic entry see Field 2F.
W91-00259

SEDIMENT AND THE ENVIRONMENT.
For primary bibliographic entry see Field 2J.
W91-00280

NITROGEN AND PHOSPHORUS IN ERODED SEDIMENT FROM CORN AND SOYBEAN TILLAGE SYSTEMS.
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
G. F. McIsaac, M. C. Hirschi, and J. K. Mitchell.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 3-10, 2 fig, 2 tab, 18 ref.

Descriptors: *Agricultural runoff, *Erosion, *Nonpoint pollution sources, *Runoff, *Soil erosion, *Tillage, *Water pollution sources, Agriculture, Contour terracing, Corn, Cropland, Illinois, Nitrogen, Phosphorus, Sediment analysis, Sediment chemistry, Simulated rainfall, Soybeans.

Midwestern U.S. cropland soils have been eroding at rates believed to be damaging to the productivity of the soils. Runoff, soil loss and sediment bound total Kjeldahl nitrogen (TKN) and Bray P-1 phosphorus losses from simulated rainfall were measured from five alternative corn and soybean tillage systems. Runoff and soil losses were influenced by contouring and tillage treatment. TKN concentration in the sediment was not greatly affected by tillage treatment and the average TKN enrichment ratio was 1.15. Bray P-1 concentration in the soil and eroded sediment was significantly reduced by inversion plowing, and concentrations in the eroded sediment tended to decrease as soil loss increased. Bray P-1 enrichment ratios ranged from 1.7 to 4.5, and variations were not well correlated with soil loss. (See also W91-00280) (Author's abstract)
W91-00281

ROLE OF SEDIMENT IN METOLACHLOR TRANSPORT FROM AGRICULTURAL FIELDS.
Trent Univ., Peterborough (Ontario). Dept. of Geography.
J. M. Buttle.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p. 11-18, 3 fig, 3 tab, 8 ref.

Descriptors: *Agricultural runoff, *Fate of pollutants, *Herbicides, *Nonpoint pollution sources, *Path of pollutants, *Sediments, *Water pollution sources, Agricultural chemicals, Canada, Metolachlor, Ontario, Peterborough, Rainfall, Water table.

The increased use of herbicides in agricultural activities has heightened public concern over their potential to contaminate surface and subsurface waters. A two year investigation of the hydrological pathways of metolachlor transport from application site to receiving water bodies was undertaken using a corn field located 15 km south of Peterborough, Ontario, Canada. Examination of metolachlor concentrations and loads in the dissolved and suspended phases in runoff water revealed that sediment can be an important transport vector in the movement of relatively soluble herbicides from site of application. The proportion of total metolachlor yield carried on sediment ranged from 9 to 70% for natural rainstorms on experimental plots. Near-stream water table conditions appeared to determine whether field exports of metolachlor and sediment enter adjacent streams or are deposited in footslope areas. (See also W91-00280) (MacKeen-PTT)
W91-00282

TRANSPORT OF MINE TAILINGS AS SUSPENDED SEDIMENT IN THE BELLE FOURCHE RIVER, WEST-CENTRAL SOUTH DAKOTA, USA.
Geological Survey, Indianapolis, IN. Water Resources Div.
D. C. Marron.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p. 19-26, 3 fig, 8 ref.

Descriptors: *Arsenic, *Mine wastes, *Path of pollutants, *Sediment contamination, *Sediment transport, *Suspended sediments, Alluvium, Belle Fourche River, Flood plains, Gold mining, River sediments, South Dakota, Whitehead Creek.

Millions of tons of mine tailings that were discharged into Whitehead Creek in South Dakota between the late 1800's and 1978 were transported through the Belle Fourche River or deposited on its flood plain. Arsenic concentrations in overbank deposits along the Belle Fourche River record the dilution of transported mine tailings by uncontaminated alluvium during overbank flow. Arsenic concentrations decrease in a downstream direction and are smallest in sediments that were deposited by the highest streamflow. Background and pre-1978 suspended sediment data collected at gauging stations on the Belle Fourche River also indicate increasing dilution of mine tailings by uncontaminated alluvium with increasing distance downstream and at higher streamflow. Calculations of pre-1978 mine tailings transport at two gauging stations along the Belle Fourche River illustrate the capacity of the Belle Fourche River to transport a large, fine-grained sediment load, and the ability of flood plains to store large amounts of fine-grained sediment. (See also W91-00280) (Author's abstract)
W91-00283

SEDIMENT-ASSOCIATED TRANSPORT AND REDISTRIBUTION OF CHERNOBYL FALLOUT RADIONUCLIDES.
Exeter Univ. (England). Dept. of Geography.
D. E. Walling, J. S. Rowan, and S. B. Bradley.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p. 37-45, 3 fig, 2 tab, 6 ref.

Descriptors: *Fallout, *Path of pollutants, *Sediment contamination, *Sediment transport, *Water pollution sources, Cesium radioisotopes, Chernobyl, England, Flood plain sediments, Radionuclides, River Severn, Sediment analysis, Suspended sediments, Wales.

Fallout of Chernobyl-derived radionuclides over the UK evidenced marked spatial variation. Relatively high levels were recorded in central Wales, but they declined rapidly to the east. As a result the headwaters of the River Severn received significant inputs of fallout, whereas only low levels were recorded over the middle and lower reaches. Measurements of the cesium-137 content of suspended sediment transported by the River Severn and of channel and floodplain sediments collected from various locations within the basin have been used to assess the importance of fluvial transport and redistribution of Chernobyl-derived radionuclides. High concentrations of cesium-137 (up to 1450 mBq/g) were recorded in suspended sediment collected from the lower reaches of the river shortly after the Chernobyl incident and substantial accumulations of Chernobyl-derived radionuclides have been detected in floodplain and channel sediments collected from areas which received only low levels of fallout directly. (See also W91-00280) (Author's abstract)
W91-00285

METAL DISPERSAL IN THE FLUVIAL SYSTEM OF THE RIVER GEUL: THE ROLE OF DISCHARGE, DISTANCE TO THE SOURCE, AND FLOODPLAIN GEOMETRY.
Utrecht Rijksuniversiteit (Netherlands). Dept. of Geography.
H. Leenaers, and M. C. Rang.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 47-55, 5 fig, 4 tab, 19 ref.

Descriptors: *Heavy metals, *Mine wastes, *Path of pollutants, *River sediments, *Sediment contamination, *Sediment transport, *Water pollution sources, Cadmium, Flood plain sediments, Flood plains, Geul River, Lead, Suspended sediments, The Netherlands, Zinc.

Due to mining activities in the past, the floodplains of the River Geul in the Netherlands are severely polluted with heavy metals, especially lead, zinc and cadmium. In the present situation, two active sources of heavy metals were recognized. Older floodplain sediments, which have been contaminated by the disposal of solid waste, are reworked and continue to function as a major source of heavy metals during floods. Erosion and leaching of spoil heaps that are still present along the channel and on the river banks are additional sources of heavy metals. As a result of an increased activity of these sources during flood events, for at-a-station measurements only a weak negative relation was found between river discharge and metal concentration of suspended sediments. However, downstream observations reveal an exponential decay of metal concentrations that is due to dilution with relatively clean bed, bank and hillslope material. Moreover, differences in geochemical mobility and specific density may cause metal-specific decay rates during low flow conditions. During flood events suspended sediments are deposited in the floodplain area. Local floodplain characteristics such as inundation frequency and geomorphology reflect a spatial pattern of soil pollution that consists of local deviations from the general, exponential decay pattern. (See also W91-00280) (Author's abstract)
W91-00286

CROPPING SYSTEMS EFFECTS ON RUNOFF, EROSION, WATER QUALITY, AND PROPERTIES OF A SAVANNA SOIL AT ILORIN, NIGERIA.
Ohio State Univ., Columbus. Dept. of Agronomy.
R. Lal.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 67-74, 1 fig, 8 tab, 19 ref.

Descriptors: *Agricultural runoff, *Erosion, *Nonpoint pollution sources, *Runoff, *Soil erosion, *Tillage, *Water pollution sources, Africa, Crop yield, Cropping, Farm management, Ilorin, Nigeria, Savannas, Soil compaction, Soil properties, Tropical regions.

Soil erosion and land degradation are severe problems in some ecological regions of tropical Africa. The effects of five cropping systems and tillage methods on runoff, erosion and soil properties were investigated for a savanna soil on field runoff plots from 1983-1985. Treatments consisted of traditional farming, no-till, plow-till, alley cropping and bush fallow control. The mean annual runoff for 1983 and 1984 was trace amounts for bush fallow, 38 and 44 mm for traditional farming, 29 and 11 mm for no-till, 36 and 61 mm for plow-till, and 77 and 39 mm for alley cropping treatments. Annual soil erosion for 1983 and 1984 was trace amounts for bush fallow, 779 and 1139 kg/ha for traditional farming, 319 and 133 kg/ha for no-till, 984 and 3318 kg/ha for plow-till, and 1520 and 172 kg/ha for alley cropping. Soil physical and hydrological properties and crop yields were satisfactory in the traditional farming system. Vehicular traffic caused soil compaction in other treatments. Among cropped plots, runoff and erosion were less in no-till compared with other treatments. (See also W91-00280) (Author's abstract)
W91-00288

SOIL EROSION AND FLOODPLAIN SOIL POLLUTION: RELATED PROBLEMS IN THE GEOGRAPHICAL CONTEXT OF A RIVER BASIN.
Utrecht Rijksuniversiteit (Netherlands). Dept. of Geography.
H. Leenaers, and C. J. Schouten.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 75-83, 3 fig, 5 tab, 26 ref.

Descriptors: *Erosion, *Nonpoint pollution sources, *Soil erosion, *Surface runoff, *Urbanization, Agriculture, Bank erosion, Flash floods, Flood peak, Flood plain sediments, Floods, Heavy metals, Limburg, Mine wastes, River Geul, River basins, Sediment contamination, The Netherlands.

In the Netherlands, as in other parts of western Europe, a slow process of land use changes began in the 1950s. Due to an increase of the urban area and sealed roads, as well as a scale enlargement and modernization in agricultural practice, the infiltration capacity of the physical environment has decreased. In the hill country of the province of Limburg this process has contributed to an increase in surface runoff, causing severe problems of water damage in urban areas and soil erosion on agricultural cropland. The discharge of the River Geul, with a catchment area of 350 sq km, heavily depends on rainfall. The increasing amount of surface runoff is reflected in a flashier discharge regime, i.e. under similar rainfall conditions a higher peak discharge is produced in the present situation as compared to the situation in the 1950s. Because of mining activities in the past, the alluvial deposits in the Geul valley are severely polluted with heavy metals (lead, zinc and cadmium). During floods, the contaminated streambank deposits are eroded and therefore continue to act as a source of heavy metals. This process of sediment reworking has intensified since the 1950s, as can be derived from an increase of the rate of channel migration and the frequency and magnitude of floods. As a result, the area that is regularly flooded has grown and contaminated sediments are deposited in the floodplains at high rates. (See also W91-00280) (Author's abstract)
W91-00289

FLOCCULATION OF SUSPENDED SOLIDS IN SOUTHERN ONTARIO RIVERS.
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W91-00291

PLACER MINING OPERATIONS AND MODIFICATIONS OF THE PHYSICAL CHEMICAL NATURE OF THE WATERS OF THE RIO KAKA DRAINAGE BASIN (ANDES, BOLIVIA).
Office de la Recherche Scientifique et Technique

Outre-Mer, La Paz (Bolivia).
J. L. Guyot, and G. Herail.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 115-121, 6 fig, 2 tab, 6 ref.

Descriptors: *Mine wastes, *Suspended load, *Suspended solids, *Water pollution sources, *Water quality, Andes, Bolivia, Challana River, Consata-Mapiri River, Dissolved solids, Gold mining, Kaka River, River sediments, Tipuani River.

The influence of the exploitation of gold placers in the Bolivian Andes on water quality was examined. Three rivers were studied: the lightly exploited Challana River, the Tipuani River, where exploitation is intense in low water, and the Consata-Mapiri River, where extraction takes place on terraces and effluents are not poured directly into the river. In low water periods, when mining activity was maximal, suspended load increased strongly, up to 130 times the natural value observed in the Challana River. In a low water period, the yields to the Kaka River from the Tipuani River were 8.4% of the discharge, 4.4% of the total dissolved solids (TDS), but 77.8% of the total suspended solids (TSS). The Challana River supplied 12.0% of the discharge, 6.3% of the TDS and 0.8% of the TSS to the Kaka River. The increase in TSS was still noticeable at the foot of the Andes, 200 km downstream. On the other hand, no influence of mining activity on TDS was observed. (See also W91-00280) (MacKeen-PTT)
W91-00293

MODELLING AGRICULTURAL RUNOFF: OVERVIEW.
National Water Research Inst., Burlington (Ontario). Rivers Research Branch.
J. Marsalek.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 201-209, 1 tab, 19 ref.

Descriptors: *Agricultural runoff, *Computer models, *Model studies, *Nonpoint pollution sources, *Water pollution sources, Agricultural chemicals, Hydrologic models, Management planning, Planning, Reviews, Sediment yield, Watershed management.

Approaches to the modelling of agricultural runoff pollution are reviewed, and refinements of the modelling process and of existing models are proposed. According to the modelling objectives, three distinctive types of modelling are recognized: screening, planning, and design modelling. Model selection depends upon the accuracy requirements of the analysis, characteristics of the system and contaminants studied, and available data and resources. The modelling process consists of three phases comprising preparation of input data, model validation or testing, and the analysis of alternatives. A list of representative agricultural runoff models includes relatively simple screening models, which do not simulate hydrological processes but produce sediment yields and or chemical loads, and planning and design models which typically simulate basin hydrology, sediment yields and some agricultural chemical loads. Suggestions for model improvement include improved documentation, wider use of geographical information systems, and refinement of models to better reflect end-user requirements. (See also W91-00280) (MacKeen-PTT)
W91-00302

TRITIUM CONCENTRATIONS IN FLOW FROM SELECTED SPRINGS THAT DISCHARGE TO THE SNAKE RIVER, TWIN FALLS-HAGERMAN AREA, IDAHO.
Geological Survey, Idaho Falls, ID. Water Resources Div.
L. J. Mann.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4156, September 1989. 20p, 2 fig, 3 tab, 15 ref.

Descriptors: *Idaho, *Path of pollutants, *Radioactive wastes, *Snake River, *Springs, *Tritium, Aquifers, Detection limits, Hazard assessment, Water quality standards.

Concern has been expressed that some of the approximately 30,900 curies of tritium disposed to the Snake River Plain aquifer from 1952 to 1988 at the INEL (Idaho National Engineering Laboratory) has migrated to springs that discharge to the Snake River in the Twin Falls-Hagerman area. To document tritium concentrations in springflow, 17 springs were sampled in November 1988 and 19 springs were sampled in March 1989. Analyses showed that the tritium concentrations were less than the minimum detectable concentration of about 0.5 pCi/mL (picocuries per milliliter) in November 1988 and less than the minimum detectable concentration of about 0.2 pCi/mL in March 1989; the minimum detectable concentration was smaller in March 1989 owing to a longer counting time in the liquid scintillation system. For comparison, the maximum contaminant level of tritium in drinking water as established by the Environmental Protection Agency. is 20 pCi/mL. Samples analyzed by the EPA indicate there has been a subtle decrease in tritium concentrations in the Snake River near Buhl since the 1970's owing to the radioactive decay of tritium that was produced by atmospheric testing of nuclear weapons in the 1950's and 1960's. In 1974-79, the concentrations were less than 0.3 +/-0.2 pCi/mL in 3 of 20 samples, whereas, in 1983-88, 17 of 23 samples contained less than 0.3 +/-0.2 pCi/mL. On the basis of these findings, aqueous waste disposal of tritium at the INEL has had no measurable effect on tritium concentrations in the springflow discharging from the Snake River Plain aquifer and in the Snake River near Buhl. This conclusion is supported by the distribution of tritium in the Snake River Plain aquifer. (Author's abstract)
W91-00336

HYDROGEOLOGY AND GROUND-WATER-QUALITY CONDITIONS AT THE GEARY COUNTY LANDFILL, NORTHEAST KANSAS, 1988.
Geological Survey, Lawrence, KS. Water Resources Div.
N. C. Myers, and P. R. Bigsby.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4114, 1989. 41p, 20 fig, 9 tab, 28 ref.

Descriptors: *Geohydrology, *Groundwater quality, *Kansas, *Landfills, *Path of pollutants, *Water pollution sources, Calcium bicarbonate, Groundwater movement, Leachates, Organic pollutants, Trace elements, Water quality standards.

Chemical analyses of water from monitoring wells installed at locations upgradient and downgradient from the landfill indicate the presence of calcium bicarbonate, sodium chloride, and mixed calcium bicarbonate sodium chloride water types. For the dominant calcium bicarbonate water type, inorganic and organic constituents indicate the presence of reducing conditions in the landfill, and increased concentrations of calcium, magnesium, sodium, bicarbonate, sulfate, chloride, ammonia, iron, manganese, and other trace elements downgradient within a leachate plume that extends northeasterly away from the landfill. The orientation of the long axis of the leachate plume does not coincide with the direction of groundwater flow, based on measurements of water-level altitude, possibly due to the effect of abundant rainfall and high river stages at other times of the year or preferential flow in very transmissive zones, and thus may indicate the dominant direction of groundwater flow. None of the organic-constituent or inorganic-constituent concentrations exceeded primary drinking water standards, but iron and manganese concentrations exceeded secondary drinking water standards. Concentrations of benzene, vinyl chloride, and 1,2-trans-dichloroethene exceeded Kansas notification levels. (Author's abstract)
W91-00338

STORM RUNOFF AND ITS EFFECTS ON THE WATER QUALITY AND BOTTOM-MATERIAL QUALITY OF CEDAR CREEK, WEST-CENTRAL ILLINOIS, 1985-6.
Geological Survey, Urbana, IL. Water Resources Div.
W. O. Freeman, A. R. Schmidt, and R. D. McFarlane.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4088, October 1989.

Descriptors: *Bottom sediments, *Illinois, *Path of pollutants, *Storm runoff, *Streams, *Urban hydrology, *Urban runoff, *Water pollution sources, *Water quality, Combined sewer overflows, Galesburg, Heavy metals, Oxygen demand, Pollution load, Storm sewers, Wastewater facilities, Water quality data, Water quality standards.

Storm-related constituent loads to a 26.2-mile reach of Cedar creek, which flows through Galesburg, IL, were estimated from measurements made at 49 combined sewers, 7 storm sewers, a wastewater-treatment facility, 3 tributaries, and 5 stream sites along the creek. Sediment oxygen demands and concentrations of sediment constituents were determined at 45 locations in the creek and tributaries. Water-quality samples from the creek indicated that concentrations of copper, lead, cadmium, zinc, iron, and oxygen-demanding wastes exceeded the state effluent standards. Odors and the amount of floating material may also have exceeded the state standards, as did storm-sewer discharge concentrations of lead, iron, and dissolved solids. Sediment concentrations of mercury, lead, chromium, cadmium, and zinc were extremely high compared to mean background concentrations for Illinois. Sediment oxygen demands ranged from 0.4 to 9.1 g/sq m/day. Agricultural runoff contributes a substantial amount of suspended solids and oxygen-demanding materials, but these sources are mostly downstream from the areas of bottom material having high sediment oxygen demands. Bottom-material samples and the locations of the subreaches with high sediment oxygen demands indicate that runoff from the ongoing highway construction did not contribute substantial amounts of metals or oxygen-demanding sediments. The locations of the majority of these sites indicated that major sources of constituents are runoff from combined sewers and storm sewers and effluent from the Galesburg wastewater-treatment facility. A sludge-application field located just upstream from the wastewater-treatment facility also is a possible source of oxygen-demanding materials. Runoff from combined sewers is a major source of cadmium, copper, lead, and zinc. The wastewater-treatment-facility effluent and runoff from the storm sewers are major sources of mercury and chromium, respectively, in streamflow and bottom materials. Mercury from the wastewater-treatment facility is most likely in the dissolved phase because suspended-solids concentrations are very low compared to other sources of runoff. (Author's abstract)
W91-00339

HYDROGEOLOGY AND SIMULATION OF GROUND-WATER FLOW AT SUPERFUND-SITE WELLS G AND H, WOBURN, MASSACHUSETTS.
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00340

WHAT IS A LEACHER.
Biospherics, Inc., Beltsville, MD. Ground Water and Environmental Programs.
S. Cohen.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 72-73,75, Summer 1990. 6 ref.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Leaching, *Mathematical models, *Nonpoint pollution sources, *Path of pollutants, *Pesticide drift, *Pesticides, Agricultural chemicals, Hydrolysis, Photolysis, Solubility coefficient, Toxicity.

The term 'leacher' has been used to describe certain pesticides for at least a decade. Often, the term is used without any definition or with a proposed definition. However, regulatory, data requirement, and user-based decisions about particular pesticides are frequently made based on this label. The various approaches that have been developed to determine the degree of leaching of a pesticide are discussed. One approach is the use of a static threshold based on various leaching criteria for the pesticide, including water solubility (>30 ppm), soil/water distribution coefficient (<5 and usually <1 or 2), Henry's Law constant (<0.01 atm-cu m/mol), speciation (negatively charged at ambient pH), hydrolysis half-life (>25 wks), photolysis half-life (>1 wk) and soil half-life (>2-3). Another approach is the use of simple screening models or indices for ranking leaching potential of pesticides. These are simple, useful algorithms that integrate pesticides and hydraulic factors. These are best used for ranking and setting priorities, rather than predicting concentrations. It is concluded that the best definition of a leacher is a pesticide that has sufficient mobility and persistence to migrate to groundwater, following normal use, at toxicologically significant concentrations. Expert judgement should be used to select the appropriate assessment method at a particular site with a particular pesticide. (Hoskin-PTT)
W91-00362

SUBSURFACE TRANSPORT OF INORGANIC AND ORGANIC SOLUTES FROM EXPERIMENTAL ROAD SPREADING OF OIL-FIELD BRINE.
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
E. S. Bair, and R. K. Digel.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 94-105, Summer 1990. 9 fig, 2 tab, 22 ref.

Descriptors: *Brine disposal, *Deicers, *Groundwater movement, *Groundwater pollution, *Path of pollutants, *Surface-groundwater relations, *Wastewater disposal, Benzene, Calcium, Chlorides, Dust control, Lysimeters, Monitoring wells, Oil fields, Potassium, Sodium, Strontium.

A study designed to evaluate groundwater quality changes resulting from spreading oil-field brine on roads for ice and dust control was conducted using a gravel roadbed that received weekly applications of brine eight times during the winter phase and 11 times during the summer phase of the study. A network of 11 monitoring wells and five pressure-vacuum lysimeters was installed to obtain groundwater and soil water samples. Thirteen sets of water-quality samples were collected and analyzed for major ions, trace metals and volatile organic compounds. Two sets of samples were taken prior to brine spreading, four sets during winter-phase spreading, five sets during summer-phase spreading, and two sets during the interim between the winter and summer phases. A brine plume delineated by elevated specific-conductance values and elevated chloride concentrations developed downgradient of the roadbed during both the winter and summer phases. The brine plume caused chloride concentrations in ground water samples to exceed EPA public drinking-water standards by two-fold during the winter phase and five-fold during the summer phase. No other major ions, trace metals or volatile organic compounds exceeded the standards during the winter or summer phases. More than 99% dilution of the solutes in the brine occurred between the roadbed surface and the local ground water flow system. Further attenuation of calcium, sodium, potassium and strontium resulted from adsorption, whereas further attenuation of benzene resulted from volatilization and adsorption. (Author's abstract)
W91-00365

PROPOSAL TO USE CHLORINE-36 FOR MONITORING THE MOVEMENT OF RADIONUCLIDES FROM NUCLEAR EXPLOSIONS.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 5A.
W91-00366

GROUND WATER RECHARGE AND POLLUTION POTENTIAL OF DRY WELLS IN PIMA COUNTY, ARIZONA.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
L. G. Wilson, M. D. Osborn, K. L. Olson, S. M. Maida, and L. T. Katz.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 114-121, Summer 1990. 3 fig, 2 tab, 26 ref.

Descriptors: *Arizona, *Disposal wells, *Dry wells, *Groundwater pollution, *Path of pollutants, *Urban runoff, *Water pollution sources, Benzenes, Chromium, Drinking water, Groundwater movement, Groundwater transport, Heavy metals, Lead, Manganese, Municipal wastes, Nickel, Pesticides, Sediment analysis, Sediment contamination, Toluene, Trace metals, Vadose zone, Volatile organic compounds, Zinc.

Urbanization of the city of Tucson and Pima County, Arizona, has increased the rate and volume of urban runoff. Dry wells are used to dispose of urban runoff is the vadose zone to comply with local detention/retention ordinances. A study was made to estimate the potential for dry-well drainage of urban runoff to recharge and pollute ground water in Tucson, Arizona. Three candidate dry wells were selected for study. At each site samples of runoff, dry-well sediment, vadose-zone sediment, perched groundwater and groundwater were collected. Water content data from vadose-zone samples suggest that dry-well drainage has created a transmission zone for water movement at each site. Volatile organic compounds, while undetected in runoff samples, were present in dry-well sediment, perched groundwater at one site, and groundwater at two sites. The concentrations of volatile organics (toluene and ethylbenzene) in the water samples were less than the corresponding EPA human health criteria. Pesticides were detected only in runoff and dry-well sediment. Lead and chromium occurred in runoff samples at concentrations above drinking water standards. Nickel, chromium and zinc concentrations were elevated in vadose-zone samples at the commercial site. Of the metals, only manganese, detected at the residential site, exceeded Secondary Drinking Water Standards in groundwater. It is concluded that the three dry wells examined during this study are currently not a major source of groundwater pollution. (Author's abstract)
W91-00367

MODELING THE POTENTIAL EFFECT OF ADDITIVES ON ENHANCING THE SOLUBILITY OF AROMATIC SOLUTES CONTAINED IN GASOLINE.
Michigan Technological Univ., Houghton. Dept. of Civil and Environmental Engineering.
J. R. Mihelcic.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 132-137, Summer 1990. 3 fig, 2 tab, 20 ref.

Descriptors: *Computer models, *Hydrocarbons, *Path of pollutants, *Petroleum products, *Solubility, *Solute transport, Alcohols, Benzenes, Chemical analysis, Ethers, Groundwater pollution, Soil contamination, Toluene, Xylenes.

It is important to understand the transport and fate of aromatic hydrocarbons that may be released from underground storage tanks into soil-water systems, and particularly, potential transport enhancement of hazardous fuel constituents by the presence of a miscible or highly soluble fuel additive cosolvent. The potential effect of two common gasoline additives, ethanol and methyl tertiary-butyl ether (MTBE), on enhancing the solubility of the aromatic solutes benzene, toluene, ethylbenzene, o-, m-, and p-xylene, was examined using a computer model, ARSOL. Aqueous solute systems containing cosolvents ethanol and MTBE at 0, 0.1, 1, and 4.3 percent were modeled for both ethanol and MTBE systems. Five-percent and 10-percent ethanol systems were also modeled. Little solubility enhancement was predicted by modeling at cosolvent levels less than 1%. At cosolvent levels greater than 1%, predicted solute solubility increased curvilinearly with an increase in percent cosolvent; a 10 percent cosolvent system increased aromatic hydrocarbon solubility by approximately 100%. According to the model predictions, MTBE enhanced solute solubility more than ethanol, with enhancement by MTBE being approximately 10% greater than enhancement by ethanol at 4.3% cosolvent. Other concerns regarding gasoline additives are the observed reduction in partitioning of solutes to soils and sediments and the contamination of water supplies due to the high water solubility of the additives. (Author's abstract)
W91-00369

EFFECT OF HUMIC SUBSTANCES ON THE TOXICITY OF ALUMINUM TO ADULT RAINBOW TROUT, ONCORHYNCHUS MYKISS (WALBAUM).
Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
For primary bibliographic entry see Field 5C.
W91-00371

EFFECTS OF WASTES ON THE OCEAN: THE COASTAL EXAMPLE.
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-00385

BACTERIAL POLLUTION OF THE RIVER TIGRIS.
Mosul Univ. (Iraq). Dept. of Biology.
S. H. Khalaf.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 5, p 495-503, July 1990. 1 fig, 3 tab, 5 ref.

Descriptors: *Bacterial analysis, *Path of pollutants, *Tigris River, *Water pollution sources, Aerobic bacteria, Antibiotics, Coliforms, Iraq, Seasonal variation.

The Tigris River is one of the two main water sources in Iraq. It receives untreated domestic wastewater as well as the wastes of hospitals and factories. Two hundred and forty water samples were collected from the Tigris River and tested bacteriologically from the end of 1986 to the end of 1987. The mean total aerobic bacteria count was 9,700/ml while the mean total coliforms count was 10,500/100 ml, mean fecal coliform count was 4,800/100 ml, and mean fecal streptococci count was 1,400/100 ml. The counts of all types of bacteria were higher in the winter and spring than in autumn and summer months. A high level of resistance to antibiotics was observed at Station 2, which may be due to discharge of untreated hospital wastes in the area. (Author's abstract)
W91-00392

CORROSION AND WATER QUALITY.
Wisconsin Dept. of Natural Resources, Spooner. Northwest District.
D. W. Herrick.
Water Well Journal WWJOA9, Vol. 44, No. 6, p 40-42, June 1990. 5 fig.

Descriptors: *Corrosion, *Domestic water, *Drinking water, *Plumbing, *Water pollution sources, *Water quality, Copper, Flushing, Lead, Neutralization, Pipes.

Household water quality can be compromised by the dissolution of metal plumbing materials into the water they contain. The rate of corrosion varies according to the specific metal involved and the chemical make-up of the water. For example, copper is more reactive than stainless steel and soft

water is more corrosive than hard water. Of the metals used for plumbing fixtures, lead and copper pose the greatest health concern. High levels of copper in drinking water usually come from the pipe itself, whereas lead can come from several sources. However, the most common source of lead in drinking water is the lead/tin solder and lead fluxes used to join copper distribution plumbing. Factors determining the levels of lead and copper in water include: the age of the plumbing; the number and age of lead soldered joints and quality of workmanship of the joints; contact time with water; and length and diameter of the plumbing lines. The simplest precaution people can take to protect against high levels of copper or lead is to flush their water lines after six or more hours of non-use. Two to three minutes of flushing will usually eliminate stagnant water from the lines. Other steps homeowners can take is to avoid using water from the hot water tap for cooking or drinking purposes since hot water dissolves lead more readily, and by making the water supply less acidic by installing a neutralizing tank containing limestone chips or adding soda-ash with a chemical feed pump. (Fleishman-PTT)
W91-00411

ESTIMATES OF ION SOURCES IN DECIDUOUS AND CONIFEROUS THROUGHFALL.
Geological Survey, Reston, VA. Water Resources Div.
L. J. Puckett.
Atmospheric Environment ATENBP, Vol. 24A, No. 3, p 545-555, 1990. 1 fig, 5 tab, 36 ref.

Descriptors: *Acid rain, *Canopy, *Chemistry of precipitation, *Conifers, *Deciduous trees, *Throughfall, *Water pollution sources, Air pollution effects, Ecosystems, Ions, Leaching, Mathematical studies, Nitrates, Regression analysis, Sulfates, Sulfur dioxide.

One of the major questions concerning the chemistry of throughfall precipitation is the nature of the sources, and sinks of the ions that exhibit net changes relative to incident precipitation. Estimates of external and internal sources of ions in net throughfall depositions were derived for a deciduous and coniferous canopy by use of multiple regression. The external source component appears to be dominated by dry deposition of Ca(2+), SO4(2-) and NO3(-) during dormant and growing seasons for the two canopy types. Increases in the leaching rates of K(+) and Mg(2+) during the growing season reflect the presence of leaves in the deciduous canopy and increased physiological activity in both canopies. Internal leaching rates for SO4(2-) doubled during the growing season presumably caused by the increased physiological activity and uptake of SO2 through stomates. Net deposition of SO4(2-) in throughfall during the growing season appears highly dependent on stomatal uptake of SO2. Estimates of SO2 deposition velocities were 0.06 cm/s and 0.13 cm/s for the deciduous and coniferous canopies, respectively, during the dormant season, and 0.30 cm/s and 0.43 cm/s for the deciduous and coniferous canopies, respectively, during the growing season. For the ions of major interest with respect to ecosystem effects, namely H(+), NO3(-) and SO4(2-), precipitation inputs generally outweighed estimates of dry deposition input. However, net throughfall deposition of NO3(-) and SO4(2-) accounted for 20-47% and 34-50% respectively, of total deposition of those ions. Error estimates of ion sources were at least 50-100% and the method is subject to several assumptions and limitations. (Author's abstract)
W91-00415

RESEARCH ON AGRICHEMICALS IN WATER RESOURCES.
Geological Survey, Iowa City, IA.
M. R. Burkart, C. A. Onstad, and G. D. Bubenzer.
EOS EOSTAJ, Vol. 71, No. 29, p 980-981, 988, July 17, 1990. 2 fig, 19 ref.

Descriptors: *Agricultural chemicals, *Data requirements, *Groundwater pollution, *Network design, *Water pollution control, *Water pollution sources, *Water resources data, Administrative decisions, Agriculture, Alachlor, Atrazine, Carbofuran, Corn belt, Decision making, Insecticides, Land management, Land use, Nutrients, Pesticides, Water pollution, Water quality control, Water resources.

A plan to study the effects of agricultural systems on the occurrence of agricultural chemicals in the ground and surface waters is being formulated by the U.S. Department and the U.S. Geological Survey. This plan develops a protocol for collecting data, evaluating farming systems, and organizing research to determine the occurrence of agricultural chemicals in the environment. Initial research will focus on the herbicides atrazine and alachlor, the insecticide carbofuran, and the plant nutrient, nitrate. The midwestern United States cornbelt was selected as the geographic area to initiate this research activity. The combination of hydrologic boundaries and land use provides an opportunity to focus research on water quality in a distinct land-use region of the nation. The results of this work are expected to provide information needed to make decisions on land management policies and practices to improve water quality. The specific objectives of the plan are outlined. These include: (1) understanding fundamental natural processes and human input factors affecting the fate and transport of agrichemicals; (2) evaluation of farming systems to determine their effect on water quality; (3) development of new farming systems and components that protect, improve, or remediate water quality; (4) evaluation of spatial data to relate the occurrence of agricultural chemicals to human and environmental factors; (5) development and assessment of models and other decision aids that can be used to protect water quality; (6) transferring technology and information to education and technical assistance agencies; (7) development of laboratory and sampling methods to provide services to researchers; and (8) understanding the impact of agricultural chemicals and practices on other ecosystems. (Agostine-PTT)
W91-00417

STREAMFLOW AND WATER-QUALITY DATA FOR MEADOW RUN BASIN, FAYETTE COUNTY, PENNSYLVANIA, DECEMBER 1987 - NOVEMBER 1988.
Geological Survey, Harrisburg, PA.
K. M. Kostelnik, and E. C. Witt.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Rpt. 89-404, 1989. 30p, 4 fig, 14 tab, 16 ref. Prepared in cooperation with the U.S. Dept. of the Interior, Office of Surface Mining Reclamation and Enforcement and the PA Dept. of Environmental Resources, Bureau of Mining and Reclamation.

Descriptors: *Acid mine drainage, *Meadow Run Basin, *Pennsylvania, *Streamflow data, *Surface water data, *Water pollution sources, *Water quality, Coal mines, Conductance, Rainfall, Water analysis, Water temperature.

Streamflow and water quality data were collected throughout the Meadow Run basin, Fayette County, Pennsylvania, from December 7, 1987 through November 15, 1988, to determine the prevailing quality of surface water over a range of hydrologic conditions. This data will assist the Pennsylvania Department of Environmental Resources during its review of coal-mine permit applications. A water-quality station near the mouth of Meadow Run provided continuous-record of stream stage, pH, specific conductance, and water temperature. Monthly water quality samples collected at this station were analyzed for total and dissolved metals, nutrients, major cations and anions and suspended-sediment concentrations. Fourteen partial-record sites, located throughout the basin, were similarly sampled four times during the study. Streamflow and water quality data obtained at these sites during a winter base flow, a spring rainfall event, a summer rainfall event, and a low summer base flow also are presented. (Author's abstract)
W91-00431

HYDROLOGIC AND CHEMICAL-QUALITY DATA FROM FOUR RURAL BASINS IN GUILFORD COUNTY, NORTH CAROLINA, 1985-88.
Geological Survey, Raleigh, NC.
C. L. Hill.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 89-578, 1989. 105p, 7 fig, 35 tab, 15 ref. Prepared in cooperation with Guilford County Soil and Water Conservation District.

Descriptors: *Hydrologic data, *Land use, *Nonpoint pollution sources, *North Carolina, *Soil erosion, *Water chemistry, *Water pollution sources, *Water quality, Agricultural watersheds, Forest watersheds, Nitrates, Rural areas.

An investigation was begun in 1984 in Guilford County, North Carolina, to monitor water quality and soil erosion in basins with various land management practices. Hydrologic and chemical-quality data were collected from four rural drainage basins, including two agricultural basins (7.4 and 4.8 acres) cultivated in tobacco and small grains, a mixed rural land-use basin (665 acres) currently under standard land-management practices, and a forested control basin (44 acres) characterizing background conditions. Mean concentrations of total nitrite plus nitrate were 1.0 mg/L from the agricultural basin under standard land-management practices. This was nearly 10 times greater than concentrations from the forested basin. Records of streamflow discharge, chemical quality, groundwater levels, precipitation, and farming activities collected from October 1984 through September 1988 at one or more of the basins are also presented in this report. (Author's abstract)
W91-00433

HYDROLOGIC AND WATER-QUALITY DATA FOR STREAMS AND IMPOUNDMENTS IN THE COTEAU DES PRAIRIES--UPPER MINNESOTA RIVER BASIN, 1979-84.
Geological Survey, St. Paul, MN.
For primary bibliographic entry see Field 2E.
W91-00434

HYDROGEOLOGIC AND WATER-QUALITY DATA FROM WELL CLUSTERS NEAR THE WASTEWATER-TREATMENT PLANT, U.S. MARINE CORPS AIR STATION, CHERRY POINT, NORTH CAROLINA.
Geological Survey, Raleigh, NC.
L. C. Murray, and C. C. Daniel.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 89-615, 1990. 56p, 10 fig, 11 tab, 7 ref. Prepared in cooperation with the Department of the Navy, U.S. Marine Corps.

Descriptors: *Data collections, *Geohydrology, *Groundwater pollution, *Groundwater quality, *North Carolina, *Path of pollutants, *Wastewater lagoons, *Water pollution sources, *Wells, Military reservations, Observation wells, Priority pollutants, Wastewater facilities.

Hydrogeologic and groundwater quality data were collected near the wastewater-treatment plant and associated polishing lagoons at the Marine Corps Air Station, Cherry Point, North Carolina, in 1988. Between March and May 1988, two observation wells were installed upgradient and six wells were installed downgradient of the polishing lagoons and sampled for organic and inorganic U.S. Environmental Protection Agency priority pollutants. Placement of the well screens allowed sampling from both the upper and lower parts of the surficial aquifer. Natural gamma-ray geophysical logs were run in the four deepest wells. Lithologic logs were prepared from split-spoon samples collected during the drilling operations. Laboratory hydraulic conductivity tests were conducted on samples of fine-grained material recovered from the two confining units that separate the surficial aquifer and the drinking water supply aquifer; values ranged from 0.011 to 0.014 ft/day. 0.000004 to 0.000005 centimeters/sec). Static water levels were

recorded on April 25, 1988. Relatively low concentrations of purgeable organic compounds (up to 2.2 micrograms/L for dichlorodifluoromethane), acid and base/neutral extractable compounds (up to 58 micrograms/L for bis(2-ethylhexyl) phthalate), or pesticides (up to 0.03 micrograms/L for diazinon and methyl parathion) were detected in water samples collected from all of the wells. Trace metals were detected in concentrations above minimum detectable limits in all of the wells and were found to be higher in water samples collected from the downgradient wells (up to 320 micrograms/L for zinc) than in water samples from the upgradient wells. (Author's abstract)
W91-00438

HYDROLOGIC AND CHEMICAL DATA FROM SELECTED WELLS AND SPRINGS IN SOUTHERN ELMORE COUNTY, INCLUDING MOUNTAIN HOME AIR FORCE BASE, SOUTHWESTERN IDAHO, FALL 1989.
Geological Survey, Boise, ID.
D. J. Parliman, and H. W. Young.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 90-112, 1990. 35p, 4 fig, 6 tab, 5 ref. Prepared in cooperation with Department of the Air Force.

Descriptors: *Hydrologic data, *Idaho, *Path of pollutants, *Springs, *Water chemistry, *Water pollution sources, Bacterial analysis, Chemical analysis, Drinking water, Groundwater quality, Military reservations.

Hydrologic and chemical data were collected during September through November 1989 from 90 wells and 6 springs in southern Elmore County, southwestern Idaho. These data were collected to characterize the chemical quality of water in major water-yielding zones in areas near Mountain Home and Mountain Home Air Force Base. The data include well and spring locations, well-construction and water level information, and chemical analyses of water from each well and spring inventoried. Groundwater in the study area is generally suitable for most uses. In localized areas, water is highly mineralized, and pH, concentrations of dissolved sulfate, chloride, or nitrite plus nitrate and nitrogen exceed national public drinking-water limits. Fecal coliform and fecal streptococci bacteria were detected in separate water samples. One or more volatile organic compounds were detected in water samples from 15 wells, and the concentration of benzene exceeded the national public drinking-water limit in a water sample from one well. (Author's abstract)
W91-00440

MACROFAUNA DISTRIBUTIONS AND SEDIMENT ANALYSES FROM THE BRUNSWICK, GEORGIA OCEAN DREDGED MATERIAL DISPOSAL SITE AND ENVIRONS.
Georgia Univ., Savannah. Marine Extension Service.
For primary bibliographic entry see Field 5E.
W91-00444

SUPERFUND RECORD OF DECISION: FRENCH LIMITED, TX.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-00447

FATE AND TRANSPORT OF PETROLEUM RELEASED FROM UNDERGROUND STORAGE TANKS.
University of Southern California, Los Angeles. E. Compton.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-188510/AS. Price codes: A03 in paper copy, A01 in microfiche. Report No. 600/9-89/030; Contract No. U-912990, 1988. 43p.

Descriptors: *Groundwater pollution, *Karst hydrology, *Literature review, *Path of pollutants, *Underground storage tanks, Drinking water, Fate of pollutants, Nonpoint pollution sources, Petroleum products, Water pollution prevention.

Because service stations having leaking hydrocarbon storage tanks are numerous and widespread, this type of contamination is considered a nonpoint source of pollution. The goal of this study was to determine the transport and ultimate fate of petroleum products within a region of karst geomorphology. Arkansas, Louisiana, New Mexico, Oklahoma, and Texas (the five states forming U.S. EPA Region VI) constituted the designated study area. With the exception of Louisiana, each state within the region has large karst aquifers. A complete literature review, including references that pertain to contaminant transport within karst aquifers and the remediation of hydrocarbon spills, was entailed. Five mechanisms control the fate of petroleum products in the subsurface: (1) vaporization, (2) solubility, (3) adsorption, (4) transformation, and (5) biodegradation. To determine the ultimate fate of petroleum products in karst terrain, these five processes need to be quantified for each specific case. Stricter standards must be imposed for regulating underground storage tanks that overlie karst. Rather than corrective actions, preventive measures (such as improved inventory control, leak detection, and upgraded tank specifications) are necessary to protect the quality of drinking water provided by carbonate aquifers. (Shidler-PTT)
W91-00452

SPATIAL ALLOCATION FACTOR PROCEDURES FOR THE 1980 NAPAP (NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM) EMISSIONS INVENTORY DOCUMENTATION.
Alliance Technologies Corp., Bedford, MA.
T. A. Beaulieu, and L. G. Modica.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-159479/AS. Price codes: A13 in paper copy, A01 in microfiche. Report No. EPA/DF/MT-89/02a; EPA/600/7-88/024a; Contract No. 68-02-4274, Tasks 1 and 4, December 1988. 284p, 6 fig, 5 tab, 7 ref, append.

Descriptors: *Acid rain, *Air pollution, *Computer programs, *Model studies, *National Acid Precipitation Assessment, *Spatial allocation, Data processing, Housing, Human population, Land use.

The development of spatial allocation factors to apportion NAPAP area source emissions from counties to individual grid cells for input to the Regional Acid Deposition (RADM) and Regional Oxidant (ROM) Models is documented. The development effort focused on creating a variety of spatial surrogates to allow the user maximum flexibility in assigning area source emissions to modeling grid cells. The surrogates are used to represent the sub-county distribution of area source emissions for each category. Fourteen surrogate indicators were developed for use with the NAPAP inventory based on housing, population, and land use data. Fortran programs were developed to generate the spatial factors. These programs are available on a companion magnetic tape. The user can specify processing options and grid definition by means of control option files accessed by the programs. Once the sub-county distribution of each surrogate is determined, area source emissions categories are matched to the most appropriate surrogate. The resultant Spatial Allocation Factor File is input to the Spatial Allocation Module of the Flexible Regional Emissions Data System. (Author's abstract)
W91-00453

WATER CHLORINATION: CHEMISTRY, ENVIRONMENTAL IMPACT AND HEALTH EFFECTS. VOLUME 6.
For primary bibliographic entry see Field 5F.
W91-00476

PRODUCTION OF ORGANIC CHEMICALS AND MUTAGENS DURING CHLOI INATION OF AMINO ACIDS IN WATER.
Water Research Centre, Medmenham (England). Medmenham Lab.
For primary bibliographic entry see Field 5F.
W91-00485

FORMATION AND PROPERTIES OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE, A POTENT MUTAGEN IN CHLORINATED WATERS.
Abo Akademi, Turku (Finland). Lab. of Forest Products Chemistry.
B. Holmbom, L. Kronberg, P. Backlund, V. Langvik, and J. Hemming.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 125-135, 2 fig, 5 tab, 26 ref.

Descriptors: *Chlorination, *Pulp and paper industry, *Wastewater treatment, *Water treatment, Ames test, Bleaching wastes, Drinking water, Humic acids, Industrial wastewater, Mutagens.

In the late 1970s, chlorination stage liquors of wood pulp bleaching, and concentrations of chlorinated drinking waters were reported to be mutagenic in the Ames test. Since then, much research has been devoted to identifying the active mutagens formed during chlorination of lignin and humic substances. Numerous chlorinated mutagens have been identified in drinking waters as well as in wood pulp bleaching liquors. An extremely strong Ames mutagen was isolated from bleaching liquors by a multistep isolation procedure and its structure was determined to be 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX). This previously undescribed compound, coded MX was stated to be a major TA100 mutagen in wood pulp chlorination liquors. Results in this study verify that MX is a major mutagen, although a minor component, both in chlorination liquors from wood pulp bleaching and in chlorinated drinking waters. MX can contribute to more than half of the total mutagenicity. MX is also formed during chlorine dioxide treatment of humic material. With aerobic biological water treatment, MX decreases to below or close to its detection level. Lignin and lignin degradation products released from pulp mills can be precursors to the formation of mutagens in drinking water plants using surface waters polluted by pulp mills. (See also W91-00476) (Lantz-PTT)
W91-00486

IMPORTANCE OF GLUTATHIONE IN THE IN VITRO DETOXIFICATION OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE, AN IMPORTANT MUTAGENIC BY-PRODUCT OF WATER CHLORINATION.
Environmental Protection Agency, Cincinnati, OH.
J. R. Meier, R. B. Knohl, B. A. Merrick, and C. L. Smallwood.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 159-170, 6 fig, 3 tab, 10 ref.

Descriptors: *Chlorination, *Fate of pollutants, *Glutathione, *In vitro tests, *Water pollution sources, *Water treatment, Ames test, Liver, Mammals, Mutagens, Toxicity.

3-Chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX) was originally isolated and identified in chlorination-stage effluents of wood pulp mills and was estimated to account for 30 to 50% of the mutagenicity of the chlorinated pulp effluent as determined in a Salmonella mutagenicity assay (Ames test). Experiments indicate that MX is a substrate for conjugation with glutathione (GSH) and that this reaction results in its inactivation as a mutagen. At the levels of GSH present in the mammalian liver, it appears likely that any MX reaching the liver would be readily conjugated and

excreted, either unchanged via the bile or after further conversion to a mercapturic acid via the urine. Other liver cystolic activities also may play a role in reducing the reactivity of MX. The detoxification of MX by the liver may explain the lack of genotoxic activity for mouse bone marrow in this experiment. Further investigation into possible organ-specific effects seems warranted before any conclusions are drawn about the in vivo genotoxic or carcinogenic potential of MX. (See also W91-00476) (Lantz-PTT)
W91-00489

CHLORINATION OF AQUATIC FULVIC ACID AND NATURAL WATERS: ADDITIONAL BY-PRODUCTS.
ENVIRON Corp., Washington, DC.
For primary bibliographic entry see Field 5F.
W91-00490

ORGANIC REACTIONS OF CHLORINE DIOXIDE IN DRINKING WATER-A MUTAGENIC ASSESSMENT.
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
For primary bibliographic entry see Field 5F.
W91-00494

ACUTE TOXICITY, SUBLETHAL EFFECTS, AND BIOCONCENTRATION OF CHLORINATION PRODUCTS, VIRUSES, AND BACTERIA IN EDIBLE SHELLFISH: A REVIEW.
South Carolina Univ., Columbia. School of Public Health.
For primary bibliographic entry see Field 5C.
W91-00515

MEASUREMENT OF CHLORINE RESIDUALS IN CHLORINATED COOLING WATERS: EFFECT OF ORGANIC NITROGEN.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
J. N. Jenson, C. LeCloirec, and J. D. Johnson.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 535-544, 2 fig, 4 tab, 14 ref. EPRI Grant No. RP2300-7.

Descriptors: *Biofouling, *Chlorination, *Chlorine, *Path of pollutants, *Pollutant identification, *Residual chlorine, *Water treatment, Cooling water, Disinfection, Fate of pollutants, Nitrogen.

The control of cooling water biofouling processes using minimum levels of chlorine depends on the ability to measure the disinfectant chemical forms produced when chlorine is added to natural water. Chlorine added to water reacts rapidly with many substrates to produce new products, only some of which are disinfectants. Problems arise when poor biofouling control agents interfere and measure as free chlorine. The standard methods for the measurement of free chlorine residuals have been designed to minimize interference from inorganic chloramines (mono-, and dichloramine). The objective of this study was to correlate the problem of false measurements of free chlorine residuals in powerplant cooling waters with water quality parameters. Specifically, cooling water break-point chlorinations were performed, and break-point curve morphologies were related to the nitrogenous fractions. Based on experimental data, the following conclusions can be made: (1) chlorine reacts with organic nitrogen when cooling waters are chlorinated; (2) there are no significant differences between the 30 min and 2 hr break-point curves for any sample; (3) there appears to be a stable oxidant residual at high chlorine doses; (4) all techniques are subject to interferences in the measurement of free chlorine; and (5) the electrode signal decays with some samples chlorinated past the break-point. This decay is mimicked more closely by nitrogen trichloride than by N-chlorosuccinimide. (See also W91-00476) (Lantz-PTT)
W91-00517

BY-PRODUCTS OF CHLORINATION AT TEN OPERATING UTILITIES.
Environmental Protection Agency, Cincinnati, OH.
A. A. Stevens, L. A. Moore, C. J. Slocum, B. L. Smith, and D. R. Seeger.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 579-604, 4 tab, 33 ref.

Descriptors: *Chlorination, *Drinking water, *Public health, *Trihalomethanes, *Water pollution sources, *Water treatment, Chlorine, Chlorine compounds.

Organic by-products of the drinking water disinfection process have been considered a public health issue and a water treatment problem since the 1974 reporting of the formation of chloroform and three other trihalomethanes (THMs) during chlorination. It is now well established that the practice of drinking water chlorination for disinfection purposes produces numerous organic by-products other than THMs. Humic substances occurring naturally in water serve as precursor material for reaction with chlorine to produce a variety of non-THM compound classes, a large percentage of which are halogenated. The results of most available studies on this topic indicate that the number and identity of all possible chlorination by-products have not been determined. Compounds that can be attributed to the chlorination process have been found in one or more of the ten utilities' finished waters. About one-half of these compounds contain chlorine and many have been identified, but 128 compounds are still of unknown structure. (See also W91-00476) (Lantz-PTT)
W91-00521

ORGANIC HALIDE FORMATION DURING WATER TREATMENT UNDER FREE CHLORINE VERSUS CHLORAMINATION CONDITIONS.
Arizona Univ., Tucson. Dept. of Civil Engineering.
G. L. Amy, J. H. Greenfield, and W. J. Cooper.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 605-621, 2 fig, 6 tab, 20 ref.

Descriptors: *Chloramines, *Chlorination, *Chlorine, *Halides, *Trihalomethanes, *Water pollution sources, *Water treatment, Chloramination.

The objective of this research was to study and compare purgeable and non-purgeable organic halide formation, as well as THM formation, at two water treatment facilities operating using either free chlorine or chloramination. Both of these plants are situated in south Florida and use groundwater derived from the Biscayne Aquifer. This source water is characterized by high levels of aquatic organic matter and humic substances. The specific objectives of this study were to define and compare both short-term and long-term total organic halide (TOX), purgeable organic halide (POX), nonpurgeable organic halide (NPOX), and total trihalomethane (TTHM) formation at each of the two facilities during periods of free chlorination versus chloramination. Both facilities were sampled during each of two periods of temporary free chlorination. In this study, the NPOX fraction derived from free chlorination constituted as much as 78 and 91%, respectively, of the TOX found. This NPOX fraction has not been thoroughly characterized, nor have its potential health effects been adequately studied. THMs account for most of the POX found in waters derived from the use of either free chlorine or chloramines. (See also W91-00476) (Lantz-PTT)
W91-00522

EFFECT OF PREOZONATION ON TRIHALOMETHANE AND TOTAL ORGANIC HALOGEN FORMATION AT THE LOUISVILLE WATER COMPANY.
Louisville Water Co., KY.
For primary bibliographic entry see Field 5F.
W91-00523

TRIHALOMETHANE FORMATION POTENTIAL AND ORGANIC CONTENT: A NEW ANALYTICAL APPROACH.
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
For primary bibliographic entry see Field 5F.
W91-00524

CHLOROFORM FORMATION BY THE TRANSFER OF ACTIVE CHLORINE FROM MONOCHLORAMINE TO PHLOROACETOPHENONE.
RPC Environmental Management, Inc., Chicago, IL.
K. V. Topudurti, and C. N. Haas.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 649-664, 9 fig, 4 tab, 13 ref.

Descriptors: *Chlorination, *Chlorine, *Chloroform, *Trihalomethanes, *Water pollution sources, *Water treatment, Chemical reactions, Chloramination, Humic acids, Hydrogen ion concentration, Public health.

Trihalomethanes (THMs) are formed during the chlorination of waters containing precursors, predominantly humic substances, with chloroform being the predominant species. The kinetics and mechanism of THM formation in the reaction between free available chlorine (FAC) and model precursors were investigated by several researchers. This study demonstrated that chloroform can be formed as a product of the reaction between phloroacetophenone (PAP) and monochloramine at a neutral pH. Though the concentration of chloroform formed when monochloramine was the chlorinating agent was two orders of magnitude less than the chloroform concentration formed when FAC was the chlorinating agent, monochloramine could still produce chloroform in concentrations that could pose a health hazard. The kinetics of PAP disappearance were found to be first order in both PAP and the chlorinating agent. The rate constant was about five times greater. Results show that there is a direct transfer of Cl from NH2CL to PAP, leading to the formation of CHCl3 which may be of concern the treatment plant managers that are planning to switch to chloramination from chlorination. (See also W91-00476) (Lantz-PTT)
W91-00525

TRIHALOMETHANE FORMATION AND DISTRIBUTION IN BROMIDE-RICH AND AMMONIA-CONTAINING LAKE WATER.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
M. Rebhun, L. Grosman, J. Manka, D. Kimel, and B. Limoni.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 665-680, 9 fig, 3 tab, 10 ref.

Descriptors: *Ammonia, *Bromides, *Chlorination, *Lake Tiberias, *Path of pollutants, *Trihalomethanes, *Water pollution sources, *Water treatment, Chemical reactions, Graphical analysis, Halogens, Oxidation.

The major processes affecting trihalomethane (THM) formation and distribution (such as haloamination, oxidation of bromide to bromine, and the bromination or chlorination of the precursors) dominate differently at various sections of the

breakpoint chlorination curve. Thus, different formation modes and THM distribution along the chlorination curve can be expected. A study of THM formation and distribution in bromide-rich and ammonia-containing Lake Galilee water is reported. Results of the study conclude that: (1) high concentrations of THMs were formed in the pre-breakpoint region and significant THM production was obtained at pre-peak chlorine doses; (2) in bromide-free waters, no significant THM formation was observed in the pre-breakpoint region; (3) pre-peak and most of the pre-breakpoint THM formation was from a fast reacting precursor in the Lake Galilee water; (4) bromoform was the dominate THM from breakpoint; (5) the fastest THM formation rate was about 0.18 micrograms/L/hour; (6) 45% of total precursors showed fast kinetics; and (6) in the post-peak breakpoint region, the oxidation of bromide to bromine (hypobromous acid) was the fastest reaction. (See also W91-00476) (Lantz-PTT)
W91-00526

CHLORINATION OF SURFACE WATERS: EFFECTS OF BROMIDE CONCENTRATION ON THE CHLOROPICRIN FORMATION POTENTIAL.
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
H. Thibaud, J. DeLatt, and M. Dore.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 681-690, 3 fig, 3 tab, 10 ref.

Descriptors: *Bromides, *Chlorination, *Chloropicrin, *Wastewater treatment, *Water pollution sources, *Water treatment, Brominated hydrocarbons, Disinfection, Surface water.

The objectives of the investigation were (1) to determine the nature of organic precursors for chloropicrin formation from the chlorination of surface waters; and (2) to examine the influence of bromide concentration on the production of chloropicrin. Chlorination of raw sewage samples showed that an average of 90% of chloropicrin was produced from the organic precursors in the > 500 molecular weight range. Chloropicrin formation potentials obtained from various isolated aquatic humic materials and from natural waters were found to vary from 0.1 to 1.5 micrograms CCl3NO2/mg C. A decrease in the concentration of chloropicrin with increasing bromide concentrations was observed, and brominated trihalonitromethanes (CCl2BrNO2, CClBr2No2, CBr3NO2) were identified from the chlorination of simple organic nitro compounds in the presence of bromide. (See also W91-00476) (Lantz-PTT)
W91-00527

CORRELATIONS BETWEEN MEASUREMENTS OF ORGANIC HALIDE AND SPECIFIC HALOGENATED VOLATILE ORGANIC COMPOUNDS IN CONTAMINATED GROUNDWATER.
Arizona Univ., Tucson. Dept. of Civil Engineering.
G. Amy, J. H. Greenfield, and W. J. Cooper.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 691-701, 3 fig, 4 tab, 8 ref.

Descriptors: *Chlorination, *Groundwater pollution, *Halides, *Organic compounds, *Volatile organic compounds, Drinking water, Pollutant identification, Tetrachloroethylene, Trichloroethane, Trichloroethylene.

Considerable attention has focused on groundwater contamination by volatile organic compounds (VOCs). Halogenated VOCs are of particular concern because of their impact on drinking water quality. The specific halogenated VOCs that occur most often in contaminated groundwater systems are: trichloroethylene, tetrachloroethylene, 1,1,1-trichloroethane, and cis-, or trans-1,2-dichloroethene. Analysis of groundwater samples for specific VOCs is a time consuming and expensive endeavor requiring considerable analytical expertise. Recent developments in analytical procedures that may prove useful as monitoring tools for groundwater contamination involving halogenated organic compounds, include total organic halide (TOX) analyzers. The primary objective of this study was to compare measurements of individual halogenated VOCs with measurements of a nonspecific parameter, organic halide. Aliquots of a series of contaminated groundwater samples were analyzed for 15 individual halogenated VOCs by gas chromatography. Based on the formula weight and known chlorine content of each of the various measured compounds, an organochlorine concentration was calculated for each sample. The specific objectives of this study were to define statistical correlations between calculated organochlorine concentrations and measured TOX and to ascertain the utility of organic halide measurements as a potential monitoring tool in assessing the degree and extent of groundwater contamination. The organic halide parameter that was derived from either the TOX or POX mode of operation, provides a reasonably accurate estimate of the totality of chlorinated organic compounds present in samples of contaminated groundwater containing complex mixtures. (See also W91-00476) (Lantz-PTT)
W91-00528

EFFECTS OF COPPER (II) ON THE PRODUCTION OF TRIHALOMETHANES IN MODEL AND NATURAL WATERS.
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
F. E. Scully, G. D. Howell, and M. Speed.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 703-712, 3 fig, 28 ref. EPA Agreement No. CR-809333.

Descriptors: *Chlorination, *Copper, *Trihalomethanes, *Water pollution sources, *Water treatment, Algae, Chemical reactions, Copper sulfate, Fulvic acids, Humic acids, Model studies, Natural waters.

Natural waters contain a complex mixture of organic compounds that can react with aqueous chlorine to form trihalomethanes (THMs). The reaction of humic and fulvic acids, which compose the largest fraction of organic substances in natural waters, is believed to be the major source of these compounds. Attempts to correlate the THM formation potential (THMFP) of natural waters with a simple chemical parameter, such as total organic carbon, have revealed only crude relationships and demonstrated that the characteristics of the organic components of various waters differ widely. Because many utilities add copper(II) to their raw waters to inhibit algal growth, and because both proteins and humic acids form complexes with copper(II), an investigation of the effect on the THMFP in model and natural waters having trace quantities of copper sulfate has been conducted. Proteins appear to be the major portion of amino nitrogen compounds in natural waters. Copper(II) forms complexes with the peptide bond of proteins in a reaction that is used by biochemists to quantitate protein concentrations. It was been shown that coordination of copper(II) by the peptide bond facilitates the formation of copper(III). The effect of added copper(II) on the reaction of a model protein with aqueous hypochlorite to produce THMs was studied along with the effect of added nitrite to see if the THM forming reaction might be affected by its presence. It was determined that although proteins contributed significantly to the THMFP, the nonprotein fraction (humic acid) still appeared to contribute the major portion of the THMFP. (See also W91-00476) (Lantz-PTT)
W91-00529

INFLUENCE OF ORGANIC NITROGEN COMPOUNDS ON THE PRODUCTION OF ORGANOCHLORINE COMPOUNDS IN THE CHLORINATION OF HUMIC MATERIAL.
Technische Hogeschool Delft (Netherlands). Lab. for Analytical Chemistry.
For primary bibliographic entry see Field 5F.
W91-00534

CHLORINATED ORGANIC BY-PRODUCTS OF THE REACTION OF N-CHLOROPIPERIDINE WITH STOMACH FLUID FROM LABORATORY ANIMALS.
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
K. E. Mazina, F. E. Scully, and H. P. Ringhand.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 809-817, 2 fig, 1 tab, 14 ref. EPA Agreement No. CR-813092.

Descriptors: *Chemical reactions, *Chlorination, *Chlorine, *Chloropiperidine, *Path of pollutants, *Stomach, *Water pollution sources, *Water treatment, Biodegradation, Chloramines, Drinking water, Hydrogen ion concentration.

Because of the large number of the population exposed to chlorine oxidants used to disinfect drinking water, the long-range health effects of ingestion of these compounds are of interest. However, in the design of meaningful toxicological experiments, the chemistry of these labile oxidants in the gastrointestinal system should be understood. Recently, several N-chloramino acids have been identified which are formed when hypochlorous acid is mixed with stomach fluid from laboratory rats. At concentrations of hypochlorite administered to animals in toxicological studies, organic N-chloramines appear to form in the stomach and may contribute to the toxicological effects of aqueous chlorine observed in animal studies. In experiments that are described in this study, it became clear that N-chloropiperidine at concentrations of stomach fluid above 100 mg/L (as Cl2) was not completely reduced by components of stomach fluid, especially at pH values greater than 6. The amount of reduction becomes greater as the pH becomes lower, but only at the lowest pH value is chloramine almost completely reduced at all chloramine concentrations below 100 mg/L (as Cl2). These results suggest that the reducing capability of stomach fluid is pH dependent and can be exceeded at concentrations frequently used in toxicological experiments. If inorganic monochloramine is used in animal experiments in buffered solutions at pH values above 8, toxicological values may be skewed by the chemistry. (See also W91-00476) (Lantz-PTT)
W91-00538

SOME PHYSICAL AND CHEMICAL CHARACTERISTICS OF AN UNIDENTIFIED PRODUCT OF INORGANIC CHLORAMINE DECOMPOSITION.
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W91-00539

CHEMISTRY OF BROMINE TRANSFER: DISPROPORTIONATION AND HYDROLYSIS IN BROMAMINE SYSTEMS.
Hartford Univ., West Hartford, CT. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W91-00540

PROPOSED MECHANISM FOR THE REACTIONS OF CHLORINE DIOXIDE WITH AQUATIC ORGANIC MATERIALS.
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
For primary bibliographic entry see Field 5F.
W91-00541

HYDROLYSIS CONSTANTS OF CHLORINE MONOXIDE AND BROMINE CHLORIDE IN WATER.
Stanford Univ., CA.
M. Reinhard, G. D. Redden, and E. A. Voudrias.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 859-870, 3 fig, 2 tab, 28 ref. National Science Foundation Grant CEE-81-17561.

Descriptors: *Bromine chloride, *Chemical reactions, *Chlorination, *Chlorine monoxide, *Hydrolysis, *Path of pollutants, *Water pollution sources, *Water treatment, Bromine, Calorimetry, Chemical properties, Chlorine.

Kinetic evidence has indicated that chlorine monoxide (Cl2O) and bromine chloride (BrCl), both of which may result from chlorination of water, may act as powerful halogenating agents for aromatic compounds. However, there is little reliable thermodynamic data available to assess the relative equilibrium concentrations of the two agents in water and therefore their specific reactivity. In contrast to previous studies, the calorimetric tritrations reported here do not indicate a unique set but a range of (HOCl)aq(2)/(Cl2O)aq equilibrium constants (K2) and molar heat of hydrolysis delta-h-H(0) (Cl2O) values: the Cl2O hydrolysis equilibrium constant is > 1 and delta-h-H(0) is in the range of 0 to -1kJ/mol. Solution calorimetry was found to be unsuitable for the determination of the hydrolysis equilibrium of Cl2O due to an apparent small enthalpy of reaction. The range of K2 (> 1M) derived from the calorimetric data is consistent with K2 obtained from H2O/CCl4 (282 M at 0 C) partitioning data. The small heat of reaction suggested by the data indicates a very small temperature dependence of K2. Assuming delta-h-H(0) (Cl2O) and K2 (0 C) to be 0 to -1 kJ/mol and 282 M, K2 at 20 C may be estimated to range from 274 to 282 M. Using these data along with previous data, Henry's coefficients for Cl2O and HOCl were calculated as 49 +/-5 torr/M and 0.35 +/-0.02 torr/M at 10 C. Bromine chloride, a highly reactive brominating agent, may be formed in chlorinated water containing Br(-). The hydrolysis constant of BrCl was measured and has a value of 0.000021 +/-0.000013 M(2) at 10 C; 0.000032 +/-0.26 M92) at 20 C; and 0.000034 +/-0.16 M(2) at 30 C. (See also W91-00476) (Lantz-PTT)
W91-00542

MOSES LAKE CLEAN LAKE PROJECT. FINAL STAGE 3 REPORT.
For primary bibliographic entry see Field 5G.
W91-00554

SUPERFUND RECORD OF DECISION, BRODERICK WOOD PRODUCTS COMPANY.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-00555

SUPERFUND RECORD OF DECISION MIDWEST MANUFACTURING, IO.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-00556

HYDROGEOLOGIC INVESTIGATIONS SAMPLING PLAN.
For primary bibliographic entry see Field 7A.
W91-00557

INTERACTIONS OF CONTAMINANTS WITH SEDIMENT AND WATER IN RESERVOIRS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. Gunnison.
Army Corps of Engineers Water Operations Technical Support Information Exchange Bulletin, Vol. E-90-1, June 1990. 3 p, 2 ref.

Descriptors: *Path of pollutants, *Reservoirs, *Sediment contamination, *Water chemistry, Biodegradation, Cadmium, Chemical interactions, Copper, Equilibrium, Heavy metals, Hydrogen ion concentration, Iron, Lead, Manganese, Mercury, Water quality.

Many contaminants have a high affinity for sediments. Consequently, movement of sediment bound contaminants within a project is directly linked to the movement of sediment. Sediment-water interactions play a major role in determining whether contaminants remain with the sediments or are released from them. While the scientific principles underlying these interactions are fairly well understood, the ability to quantify them and then apply this knowledge to analyze and predict the effects of contaminated sediments on water quality Corp of Engineers (CE) reservoir projects is lacking. It has been determined from recent studies that many CE reservoirs are experiencing problems resulting from contaminants in project waters and sediments. Eighteen percent of 442 CE reservoir projects were reported to have problems with organic contaminants. An identical percentage of these projects reported difficulties with pH. Thirty-three percent of the projects had problems with metals other than iron and manganese, primarily cadmium, copper, mercury and lead. Problems with manganese and iron occurred in 24-25% of the projects. The US Army Engineer Waterways Experiment Station (WES) is conducting studies to determine: adsorption/desorption rates for major contaminants; the influence of sediment concentration on equilibrium distribution coefficients and adsorption/desorption kinetics; effects of particle composition; the effects of site specific conditions and environmental factors on contaminant-sediment-water interactions; and the significance of microbial transformations and mobilization processes on contaminated levels in reservoirs. The results will assist in describing contaminant movement in reservoirs. (Lantz-PTT)
W91-00560

PESTICIDES IN GROUND WATER DATA BASE: 1988 INTERIM REPORT.
Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.
W. M. Williams, P. W. Holden, D. W. Parsons, and M. N. Lorber.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-164230. Price codes: A03 in paper copy, A01 in microfiche. EPA Report No. 540/09-89-036, December 1988. 155p, 5 fig, 5 tab, 9 ref, 6 append.

Descriptors: *Data collections, *Data storage and retrieval, *Databases, *Groundwater pollution, *Pesticides, *Pollutant identification, Computers, Monitoring.

A pesticides database was developed to compile results from monitoring studies conducted by pesticide registrants, universities and government agencies. The Pesticides in Groundwater Data Base identifies the pesticides that have been searched for in groundwater, the areas that have been monitored, and the pesticides that have been detected. An important component in the development of the database was the data confirmation program which involves contacting the director or responsible agent for each study in order to document and assess the sample collection and analysis procedures used in the study. This report outlines the development of the database, the data confirmation program, and how the database will be used by the EPA to support the registration process for pesticides. An attempt is made to segregate the results according to the quality of the study and the origin of the contamination (i.e., point source origins vs. leaching through the soil following applications in accordance with registration). The report is an interim report in that the data confirmation continues and new data is added to it daily. (Author's Abstract)
W91-00569

QUALITATIVE VALIDATION OF POLLUTANT TRANSPORT COMPONENTS OF AN UNSATURATED SOIL ZONE MODEL (SESOIL).
Oak Ridge National Lab., TN. Computing and Telecommunications Div.
D. M. Hetrick, C. C. Travis, S. K. Leonard, and R. K. Kinerson.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-008965. Price codes: A03 in paper copy, A01 in microfiche. Report No. ORNL/TM-10672, March 1989. 39p, 15 fig, 7 tab, 32 ref. DOE Contract DE-AC05-84OR21400.

Descriptors: *Aeration zone, *Model studies, *Organic compounds, *Path of pollutants, *Soil contamination, *Solute transport, Aldicarb, Atrazine, Diazinon, Groundwater pollution, Leaching, Lindane, Pesticides, Phenols.

Model predictions of a revised version of the soil compartment model SESOIL (seasonal soil) were compared with empirical measurements of pollutant transport in soil. Comparisons were performed using data from a laboratory soil column study involving six chemicals: dicamba; 2,4-dichlorophenoxyacetic acid; atrazine; diazinon; pentachlorophenol; and lindane, as well as data from field studies involving transport of aldicarb and atrazine. Results for several aspects of pollutant transport were compared including the location of the chemical peak versus time, the time dependent amount leached to groundwater, the depth distribution of the pollutant at various times, the mass of the chemical degraded, and the amount of pollutant in surface runoff. Overall, the SESOIL model predictions are in agreement with observed data for both laboratory study and field studies. (Lantz-PTT)
W91-00573

USERS MANUAL FOR THE SLUDGEMAN MODEL FOR THE GROUNDWATER PATHWAY IN THE MONOFILLING OF SEWAGE SLUDGE.
ICF Technology, Inc., Fairfax, VA.
For primary bibliographic entry see Field 5E.
W91-00575

COKRIGING TO ASSESS REGIONAL STREAM QUALITY IN THE SOUTHERN BLUE RIDGE PROVINCE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
H. I. Jager, M. J. Sale, and R. I. Schmoyer.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1401-1412, July 1990. 8 fig, 41 ref. Environmental Protection Agency Interagency Agreement 1824-1557-A1, Department of Energy Contract DE-AC05-84OR21400.

Descriptors: *Acid rain effects, *Acidification, *Kriging, *Path of pollutants, *Statistical analysis, *Streams, *Water chemistry, *Water quality, *Water quality monitoring, Acid neutralizing capacity, Headwaters, North Carolina, Southern Blue Ridge Province, Spatial distribution.

As concern for large scale environmental problems such as acid rain, global warming and climate change, ozone depletion, nonpoint source pollution of surface waters, and air pollution, has grown in recent years, the need for regional impact assessment has increased. Cokriging is used to predict stream chemistry at unsampled locations with the use of spatial and intervariable correlation. This technique was used to predict the acid neutralizing capacity (ANC) of streams in the Southern Blue Ridge Province (SBRP). ANC measurements between pairs of streams surveyed in this region were found to be spatially correlated over distances up to 40 km. Predictions were improved by including elevation in the analysis to represent the combined influence of elevational gradients in climate, geology, soils, hydrology, and vegetation on stream ANC. The cokriging analysis identified specific stream reaches predicted to be the most sensitive to acidification and located areas of high uncertainty. Stream ANC levels below 50 microeq/L were predicted for one-fifth of the upper nodes associat-

ed with digitized headwater reaches in the SBRP. The majority of these were located in the higher elevations of the Great Smokey Mountains National Park, in the vicinity of Mount Mitchell, and in the Blue Ridge Mountains in southern North Carolina. (Author's abstract)
W91-00589

COMPARATIVE ANALYSIS OF ALUMINUM BIOGEOCHEMISTRY IN A NORTHEASTERN AND A SOUTHEASTERN FORESTED WATERSHED.
Maine Univ., Orono. Dept. of Botany.
For primary bibliographic entry see Field 2K.
W91-00590

ANALYTICAL SOLUTIONS OF THE ONE-DIMENSIONAL ADVECTION EQUATION AND TWO OR THREE-DIMENSIONAL DISPERSION EQUATION.
Auburn Univ., AL. Dept. of Agronomy and Soils.
F. J. Leij, and J. H. Dane.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1475-1482, July 1990. 4 fig, 1 tab, 20 ref.

Descriptors: *Flow models, *Mathematical analysis, *Model studies, *Path of pollutants, *Porous media, *Solute transport, Advection, Dispersion, Fourier analysis, Laplace equation, Theoretical analysis.

Transport of soluble chemicals in porous media, an important topic for many researchers working in engineering, agriculture and hydrology, is generally assumed to occur by advection and dispersion. For many transport problems involving a one-dimensional flow a significant amount of solute might move in the direction transverse to the flow. The advection-dispersion equation was solved analytically to evaluate transient solute transport in a two-dimensional semi-infinite isotropic porous medium (half plane) with a step change in concentration along the inlet during one-dimensional flow. The solution was obtained with Laplace and Fourier transforms and verified with various numerical and analytical solutions. The same technique was used to obtain analytical solutions for some other concentration distributions at the inlet under conditions of either two-dimensional or three-dimensional dispersion. (Author's abstract)
W91-00594

MATHEMATICAL MODELING OF TRACER BEHAVIOR IN SHORT-TERM EXPERIMENTS IN FISSURED ROCKS.
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
P. Maloszewski, and A. Zuber.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1517-1528, July 1990. 11 fig, 2 tab, 29 ref, append. Polish Academy of Science CPBP 03.02.

Descriptors: *Geologic fractures, *Groundwater movement, *Mathematical models, *Model studies, *Path of pollutants, *Solute transport, *Tracers, Adsorption, Isotherms, Mathematical analysis, Physical properties, Porous media, Theoretical analysis.

A method was developed for the modeling of solute movement in fissured rocks. Transport equations for a single fissure in a porous matrix are coupled with a chemical model allowing for both an instantaneous equilibrium governed by a linear adsorption isotherm and a nonequilibrium kinetic reaction of the first order. The fitting procedure of the obtained solution is improved by additional fitting of the mass recovery curves, i.e., the fitting consists of a trial and error procedure applied in turn to the concentration tracer curve and the mass recovery curve until a given set of parameters gives the best fit of both theoretical curves to the experimental data. The model was tested against known multi-tracer experimental data from a fissured chalk formation. It is shown how some physical parameters can be obtained by a combined interpretation of the tracer and pumping data. However, in the case of adsorbable tracers, some of the parameters must be known from a nonsorbable tracer experiment. In spite of its approximate nature, the model works well for nonsorbable tracers and reasonably well for sorbable solutes. (Author's abstract)
W91-00598

MODELING THE MOVEMENT OF VOLATILE ORGANIC CHEMICALS IN COLUMNS OF UNSATURATED SOIL.
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
J. S. Gierke, N. J. Hutzler, and J. C. Crittenden.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1529-1547, July 1990. 8 fig, 6 tab, 51 ref.
National Science Foundation Grant ECE-8501395.

Descriptors: *Fate of pollutants, *Model studies, *Path of pollutants, *Soil water, *Unsaturated flow, *Volatile organic compounds, Clays, Diffusion, Dispersion, Experimental data, Laboratory methods, Mass transfer, Mathematical analysis, Numerical analysis, Sand, Soil columns, Tracers, Trichloroethene.

Mechanisms affecting the fate of nondegradable volatile organic chemicals (VOCs) in soils include (1) advection in air and water, (2) dispersion in air and water, (3) air-water mass transfer and equilibrium, (4) diffusion in immobile water, (5) mass transfer between mobile and immobile water, and (6) sorption. A deterministic model was developed to account for these processes in laboratory columns of unsaturated soil. The general form of the model was solved numerically. The numerical solution was verified with analytic solutions for simplified conditions. Column experiments were conducted to validate the model and to determine the relative importance of each mechanism in two soil types. The movement of trichloroethene was measured in a column packed with a uniform sand and one packed with uniformly sized aggregates that were made with clay. Parameter values for the model predictions were independently determined from direct measurements and literature correlations. Bromide tracer studies were performed to determine parameter values that could not be measured directly or were not estimated accurately by literature correlations. These parameter values were used in the model to predict the breakthrough and elution of trichloroethene in the two columns. To describe the column data, however, Henry's constant was increased from a literature value of 0.4 to 0.7, and the predicted gas dispersion coefficient was reduced by a factor of 10. Laboratory results and numerical calculations indicated the following about the mechanisms affecting the transport of VOCs in homogeneous, unsaturated soils: (1) both liquid dispersion and diffusion in immobile water are important, (2) vapor diffusion is not an important transport mechanism for trichloroethene in sands or structured soils when the average pore water velocities are greater than about 0.07 and 0.02 cm/s, respectively, and (3) the rates of mass transfer across the air-water and the mobile-immobile water interfaces are fast. (MacKeen-PTT)
W91-00599

TRANSPORT AND SEDIMENTATION OF POLLUTANTS IN A RIVER REACH: A CHEMICAL MASS BALANCE APPROACH.
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
R. Berndtsson.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1549-1558, July 1990. 5 fig, 4 tab, 37 ref.

Descriptors: *Hoje River, *Nonpoint pollution sources, *Path of pollutants, *Pollution load, *Sediment contamination, *Urban runoff, *Water pollution, Biochemical oxygen demand, Chlorides, Copper, Heavy metals, Lead, Mass transport, Phosphorus, Rural runoff, Sediment analysis, Suspended solids, Sweden, Zinc.

The River Hoje in the south of Sweden is a typical receiving water for urban and rural runoff. Mass balance calculations over a 17 month period indicate that pollutants are retained in the sediments of the investigated 5-km-long reach of the stream (90 tons of biochemical oxygen demand), 850 tons of chloride, 2.1 tons of copper, 3.2 tons of zinc, and 1.0 ton of lead.). Other pollutants such as suspended solids and phosphorus appear to be both retained and washed out, depending on loading rates and local stream conditions. The retained pollutants represent a substantial part of the total mass transport through the stream (14-47%). Almost half of the transported zinc is retained within the stream sediment. Subsequently, the deposited pollutants represent a potential pollution source. Analyses of sediment samples verify that the upper sediments contain high concentrations of heavy metals. (Author's abstract)
W91-00600

GAS EXCHANGE RATES FOR A FIRST-ORDER STREAM DETERMINED WITH DELIBERATE AND NATURAL TRACERS.
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2A.
W91-00606

EPISODIC ACIDIFICATION OF ADIRONDACK LAKES DURING SNOWMELT.
Syracuse Univ., NY. Dept. of Civil Engineering.
D. A. Schaefer, C. T. Driscoll, R. Van Dreason, and C. P. Yatsko.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1639-1647, July 1990. 7 fig, 3 tab, 38 ref.

Descriptors: *Acid rain, *Acidic water, *Adirondack Mountains, *Lake acidification, *New York, *Path of pollutants, *Snowmelt, *Water pollution sources, Acid neutralizing capacity, Nitrates, Seasonal variation, Sulfates, Water chemistry, Water pollution.

The Adirondack region of New York receives elevated inputs of acidic deposition and has geologic and edaphic characteristics which make surface waters susceptible to acidification. Maximum values of acid neutralizing capacity (ANC) in Adirondack, New York lake outlets generally occur during summer and autumn. During spring snowmelt, transport of acidic water through acid-sensitive watersheds causes depression of upper lake water ANC. In some systems lake outlet ANC reaches negative values. Outlet water chemistry from 11 Adirondack lakes during was examined 1986 and 1987 snowmelts. In these lakes, sulfate ion concentrations were diluted during snowmelt and did not depress ANC. For lakes with high baseline ANC values, springtime ANC depressions were primarily accompanied by basic cation dilution. For lakes with low baseline ANC, nitrate ion increases dominated ANC depressions. Lakes with intermediate baseline ANC were affected by both processes and exhibited larger ANC depressions. Ammonium dilution only affected wetland systems. A model predicting a linear relationship between outlet water ANC minima and autumn ANC was inappropriate. To assess watershed response to episodic acidification, hydrologic flow paths must be considered. (Author's abstract)
W91-00608

CONTAMINANT DISSOLUTION AND DIFFUSIONAL TRANSPORT WITH A STATIONARY PRECIPITATION FRONT.
California Univ., Berkeley. Dept. of Nuclear Engineering.
For primary bibliographic entry see Field 5E.
W91-00612

REGIONAL WATER QUALITY: EVALUATION OF DATA FOR ASSESSING CONDITIONS AND TRENDS.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W91-00619

MEASUREMENT OF IN SITU RATES OF SELENATE REMOVAL BY DISSIMILATORY BACTERIAL REDUCTION IN SEDIMENTS.
Geological Survey, Menlo Park, CA.
R. S. Oremland, N. A. Steinberg, A. S. Maest, L. G. Miller, and J. T. Hollibaugh.

Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1157-1164, August 1990. 6 fig, 4 tab, 35 ref.

Descriptors: *Anaerobic bacteria, *Drainage water, *Fate of pollutants, *Path of pollutants, *Radioactive tracers, *Sediment chemistry, *Selenium, *Wastewater treatment, *Water pollution treatment, Agricultural water, Denitrification, Heavy metals, Radiochemical analysis, Selenium radioisotopes, Soil treatment.

Oxyanions of selenium have been identified as toxic constituents in drainage waters from irrigated, seleniferous agricultural soils. Recently a novel process was reported by which anaerobic bacteria respire selenate, which in turn biochemically reduces this oxyanion to selenite and ultimately to elemental selenium. An understanding of how this process of dissimilatory selenate reduction operates should ultimately aid in the design of treatment schemes and the rehabilitation of selenate contaminated regions. Accordingly, a radioisotope method for measurement of bacterial respiratory reduction of selenate to elemental selenium in aquatic sediments was devised. Sediments were labeled with Se75 selenate, incubated, and washed, and Se75(s) was determined as counts remaining in the sediment. Core profiles of selenate reduction, sulfate reduction, and denitrification were made simultaneously in the sediments of an agricultural wastewater evaporation pond. Most of the in situ selenate reduction (85%) and all the denitrification activities were confined to the upper 4 to 8 cm of the profile whereas sulfate reduction was greatest below 8 cm (89% of total). The integrated areal rate of selenate reduction was 301 micromoles/sq m/day, which results in a turnover of water column selenate in 82.4 days. The rate of selenate reduction in sediments was enhanced in laboratory experiments by provision of the proper electron donors (e.g., acetate, lactate, hydrogen, etc.). When this is done in conjunction with removal of competitive electron acceptors like fertilizer-derived nitrate, a treatment scheme can be envisioned. (Author's abstract)
W91-00620

IDENTIFICATION OF SOLUBILITY-CONTROLLING SOLID PHASES IN A LARGE FLY ASH FIELD LYSIMETER.

Battelle Memorial Inst., Richland, WA. Pacific Northwest Labs.
J. S. Fruchter, D. Rai, and J. M. Zachara.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1173-1179, August 1990. 10 fig, 2 tab, 30 ref. Electric Power Research Institute, Inc. (EPRI) Contract RP2485-08, Leaching Chemistry.

Descriptors: *Fly ash, *Heavy metals, *Leachates, *Lysimeters, *Path of pollutants, *Water pollution sources, Aluminum, Barium, Calcium, Chemical interactions, Chemical speciation, Chromium, Copper, Electric powerplants, Equilibrium, Interstitial water, Ions, Iron, Pennsylvania, Silicon, Solubility, Sulfur, Water analysis.

The electric utility industry produces about 75 million tons of solid wastes annually, the vast majority of which consists of fly ash and bottom ash produced during the combustion of coal. Published accounts of fly ash leaching under field conditions are limited. In this study, samples of pore fluids and leachates were obtained from a large fly ash field lysimeter in central Pennsylvania at the Montour Power Station. The fly ash in the lysimeter was usually only partially saturated, and only 0.3 pore volumes of water leached through the lysimeter during the 3-year study period. The samples were analyzed for major and trace inorganic anions and cations. The resulting analyses were modeled by using an equilibrium speciation/solubility code to test the hypothesis that the solubilities of at least some species in the fly ash leachate were controlled by solid phases. Potential solubility-controlling solids were identified for aluminum (Al), barium (Ba), calcium Ca), chromium (Cr), copper (Cu), iron (Fe), sulfur (S), silicon (Si) and strontium (Sr) in the pore waters and leachates. Solid solutions appear to play an important role in controlling the concentrations of Ba, Sr, and Cr. The activity relationships were independent of location within the lysimeter and time of sampling. A laboratory experiment showed that equilibrium times between these nine elements and their solubility-controlling solids were on the order of days or less. Geochemical reactions controlling the concentrations of arsenic (As), boron (B), cadmium (Cd), molybdenum (Mo), and selenium (Se) were not identified. (Author's abstract)
W91-00621

MODEL OF ORGANIC CHEMICAL UPTAKE AND CLEARANCE BY FISH FROM FOOD AND WATER.

Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
K. E. Clark, F. A. P. C. Gobas, and D. Mackay.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1203-1213, August 1990. 6 fig, 5 tab, 38 ref.

Descriptors: *Animal metabolism, *Bioaccumulation, *Biological magnification, *Fish, *Model studies, *Organic compounds, *Path of pollutants, Absorption, Bioavailability, Food chains, Organic pollutants, Water pollution effects.

One of the most important environmental transport and partitioning processes is bioaccumulation. A comprehensive model was presented that describes the bioaccumulation of organic chemicals by fish from food and water, using size and species-dependent parameters describing transport and transformation 'resistances' and parameters for metabolic conversion and bioavailability. Uptake of a non-metabolizing chemical from water tends to result in the chemical adopting a fugacity in the fish approaching that in the water, as expressed by a bioconcentration factor. Uptake from food may result in a fish fugacity that is higher than the food or water fugacity, corresponding to biomagnification. This was postulated to be due to food digestion causing a fugacity increase in the gastrointestinal tract. This biomagnification phenomenon was most significant for very hydrophobic, slowly clearing, nonmetabolizing chemicals. The model also described food chain biomagnification, the dependence of fish concentration on rates of metabolism and growth, and the effect of reduced bioavailability. The model gave a satisfactory description of the phenomena of bioconcentration, biomagnification, metabolism, bioavailability, and food chain magnification for a range of chemical hydrophobicities. It demonstrated that the detailed flows of contaminant to and from the fish, through the gills and gut, vary considerably in relative magnitude and direction as the fish became contaminated. (Author's abstract)
W91-00622

FLUORESCENT POLYCYCLIC AROMATIC HYDROCARBONS AS PROBES FOR STUDYING THE IMPACT OF COLLOIDS ON POLLUTANT TRANSPORT IN GROUNDWATER.

Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
D. A. Backhus, and P. M. Gschwend.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1214-1223, August 1990. 8 fig, 3 tab, 38 ref. USAF and EPA Contract No. CR812466-01-0 and DOE Contract No. DE-FG02-86ER60413.

Descriptors: *Colloids, *Fluorescence, *Groundwater pollution, *Path of pollutants, *Polycyclic aromatic hydrocarbons, *Tracers, Analytical methods, Humic acids, Hydrophobic compounds, Perylene.

Organic colloids (OC) or inorganic colloids with organic coatings may enhance the transport of hydrophobic pollutants in groundwater. In this study, a fluorescence-quenching method was developed to assess the hydrophobic organic pollutant binding potential of organic colloids in unaltered natural waters. This method allows (1) direct assessment of the importance of OC-enhanced pollutant transport for environmental samples under in situ water chemistry conditions, without requiring the isolation of OC or separation of equilibrated phases; (2) testing of chemicals that suffer substantial wall losses from aqueous solutions; and (3) examination of unstable water samples such as anoxic samples. Experiments showed that some OC (Aldrich humic acids) fully quench OC-associated perylene fluorescence, but others (bovine serum albumin) do not. This implies that fluorescence-quenching results collected for a single OC concentration or over a limited OC concentration range provide only a lower limit estimate of the potential of OC association. Tests with groundwater, recharged with secondarily treated sewage and containing OC at approximately 1 mg of carbon/L, showed temporal variation in the ability of OC present to quench or bind perylene. (Author's abstract)
W91-00623

PO210 AND PB210 REMOBILIZATION FROM LAKE SEDIMENTS IN RELATION TO IRON AND MANGANESE CYCLING.

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
G. Benoit, and H. F. Hemond.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1224-1234, August 1990. 15 fig, 7 tab, 37 ref.

Descriptors: *Isotopic tracers, *Lake sediments, *Lead radioisotopes, *Path of pollutants, *Polonium radioisotopes, *Radioactive tracers, *Tracers, Environmental tracers, Iron, Manganese, Oligotrophic lakes, Precipitation scavenging, Radioactivity techniques.

(210)Polonium (Po210) and (210)lead (Pb210) are the final two long-lived daughters in the (238)uranium (U238) decay series. Since the source function of the two radionuclides is often known or easily measurable, they can serve as useful tracers of metal cycling in aquatic systems. In this study, the behavior of Po210 and Pb210 was studied in the water column of an oligotrophic, dimictic lake. Direct uptake of the radionuclides by sediments was negligible compared to removal on particles, and Pb210 scavenging was 4 times that of Po210. Both nuclides were found to be significantly remobilized from sediments into the stratified, anoxic water column. Releases seemed to be linked to the cycling of the transition metals, iron and possibly manganese. The distribution of both iron and Pb210 in stratified, anoxic waters can be modeled as constant release and rapid horizontal mixing/dilution; vertical turbulent transport had a negligible effect on element distributions. Upon contact with oxygen, iron rapidly reprecipitates, forming a particulate maximum and rescavenging Pb210. Unlike Pb210, much Po210 is released from sediments before overlying water becomes completely anoxic, leading to unsupported Po210. Po210 cycling in the stratified water column is more complex than that of Pb210, and additional removal mechanism(s) may be active, including perhaps oxidation of soluble Po(II) to insoluble Po(IV). (Author's abstract)
W91-00624

CONSTANT OR INCREASING NITROGEN CONCENTRATIONS IN SPHAGNUM MOSSES ON MIRES IN SOUTHERN SWEDEN DURING THE LAST FEW DECADES.

Lund Univ. (Sweden). Dept. of Ecology.
For primary bibliographic entry see Field 2H.
W91-00645

FATE OF AQUATIC AND WETLAND HABITATS IN AN INDUSTRIALLY CONTAMINATED SECTION OF THE ELBE FLOODPLAIN IN HAMBURG.

Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
C. W. Heckman.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 75, No. 2, p 133-250, 1990. 35 fig, 11 tab, 305 ref.

Descriptors: *Aquatic habitats, *Drainage, *Germany, *Land use, *Path of pollutants, *Water pollution effects, *Water pollution sources, *Wet-

lands, Air pollution, Elbe River, Estuaries, Fallout, Halogenated hydrocarbons, Heavy metals, Industrial wastes, Mercury, Silt, Species diversity.

An investigation to determine the impact of silt drying pans on a former agricultural region in the alluvial floodplain of the Elbe Estuary (Germany) revealed that some of the water bodies and upper layers of sediment already had been moderately to strongly contaminated by Cd, Cu, Ni, Pb, Zn, As, and halogenated hydrocarbons, which arrive through the air as fallout and accumulate in the wetlands. The only toxic heavy metal traced exclusively to the drying pans is Hg, which is only detectable in water bodies directly contaminated with the Elbe silt and has not yet reached appreciable concentrations. Some local sources of ground water contain unusually high concentrations of ferrous or chloride ions. The most serious impact of the water drained from the drying pans on the biota can be attributed to very high concentrations of ammonium. A decimation of the species in one unmodified ditch receiving ammonium-rich outflow from the drying pans was observed during the year of the study. More damaging than the chemical contamination has been the extensive habitat destruction during the construction of the drying pans, which has eliminated completely several water bodies along with their vegetation and animals. The impoverishment of the region's diverse flora and fauna already has occurred. The shallow ditches draining the region of the drying pans act as sinks for the toxic heavy metals and persistent halogenated hydrocarbons, and the substances already deposited will present a constant danger to both man and the local wildlife for a long time to come. The deeper layers of sediment beneath the water bodies generally are free of these substances, attesting to their relatively recent input. The continual outflow of ammonium and other inorganic nutrients from the drying pans will greatly promote the eutrophication of the adjacent water bodies. Large discrepancies among numbers of species observed at individual sites were noted, but these cannot be attributed to the morphology of the water bodies, which is similar. Disregarding bacteria, the number of aquatic and marsh species found ranged from 41 to 165. (Author's abstract)
W91-00648

EFFECT OF TIDAL ACTION ON THE TRANSFORMATIONS OF NITROGEN IN FRESHWATER TIDAL FLAT SEDIMENTS.
Hamburg Univ. (Germany, F.R.). Fachbereich 14 - Biologie.
M. Kerner, H. Kausch, and G. Miehlich.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 75, No. 2, p 251-271, 1990. 7 fig, 2 tab, 47 ref.

Descriptors: *Cycling nutrients, *Germany, *Model studies, *Nitrates, *Path of pollutants, *Sediments, *Simulation, *Tidal effects, *Tidal flats, Denitrification, Differential equations, Elbe River, Estuaries, Mathematical models, Mathematical studies, Nitrification, Nitrogen, Numerical models, Oxygen.

A numerical model was used to simulate the vertical distribution of dissolved inorganic nitrate in tidal flat sediments. The effect of the periodically changing concentrations of oxygen and nitrate at the sediment surface on nitrification and denitrification during the tidal cycle was studied. The differential equations describing chemical transport and the biological sink or source reactions were solved by finite difference methods. First, the changes in the oxygen concentration with depth in the sediment were calculated by the transport of oxygen into the sediment and its biological reduction by nitrification processes. Typical nitrate profiles of the pore water were obtained for tidal flat sediments with different porosities and with different transport properties. The results show that biological processes strongly influence the nitrate profiles, causing differences in the concentrations with small changes in depth or time. It can be shown that exposure to the air and submersion of tidal flat sediments during a single tidal cycle produces alternating aerobic and anaerobic layers in the upper sediment zone. This layering moves into deeper sediment zones during the tidal cycle. The results of the numerical simulation of the nitrate distribution are correlated with the field data from sediments in the Elbe Estuary. The model predicts that only one fifth of the oxygen entering the tidal sediments is consumed by nitrification processes that lead to the nitrate concentrations measurable in the pore water. Modeled rates of nitrification and denitrification coincide with rates determined by laboratory experiments reported in the literature. The kinetics of denitrification in subtidal sediments showed a linear dependence on the nitrate concentration. In intertidal flat sediments, a Michaelis-Menten constant, K sub m, of 5 micromoles NO3-N/L was found. Thus, in this type of sediment, the horizontal and vertical transport of nitrate must influence the kinetics of denitrification. (See also W91-00650) (Author's abstract)
W91-00649

RELATIONSHIPS BETWEEN ACIDITY AND BENTHIC INVERTEBRATES OF LOW-ORDER WOODLAND STREAMS IN THE ADIRONDACK MOUNTAINS, NEW YORK.
Syracuse Univ., NY. Dept. of Civil Engineering. For primary bibliographic entry see Field 5C.
W91-00657

OXIDATION OF S(IV) IN RAIN-WATER COLLECTED IN JAPAN.
Institute of Public Health, Tokyo (Japan).
H. Hara.
Atmospheric Environment ATENBP, Vol. 24A, No. 6, p 1427-1432, June 1990. 6 fig, 2 tab, 24 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Japan, *Oxidation, *Path of pollutants, *Sulfur, Chromium, Cobalt, Hydrogen peroxide, Iron, Kinetics, Manganese, Ozone, Rain, Snowmelt, Sulfates, Sulfuric acid, Vanadium.

Rates of S(IV) oxidation in 48 rain-water and snowmelt samples collected at 15 sites in Japan were determined to assess the significance of the autoxidation in the sulfate formation channels of the aqueous phase. Sodium bisulfite aqueous solution was added to each of the samples, and the S(IV) concentration was followed by a modified West-Gaeke method. Most sample systems showed pseudo-first order kinetics, with rate constants ranging from .00001 to .003/sec. In several cases, however, the logarithmic concentration-time plot definitely deviated from a straight line. Some other kinetics for the rate expression could reproduce these non-linear plots of the reactions. Strong correlations were found between the first-order rate constant and the concentrations of some transition metals (Cr, Fe, Co, V and Mn, in order of decreasing correlation coefficients). The experimental rate constants agreed typically within a factor of three with calculations for the Mn concentration, but were much smaller than the predictions for the Fe levels. The experimental rates in the rain-water samples were applied to the atmospheric oxidation rate of SO2 and were compared with those of H2O2 and O3. Compared with strong oxidant contributions, the autooxidation catalyzed by various metal ions is likely to contribute to a limited extent. After the depletion of H2O2, however, the catalyses would contribute to the same extent as O3 reactions. (Author's abstract)
W91-00668

WET DEPOSITION OF VOLCANIC GASES AND ASH IN THE VICINITY OF MOUNT SAKURAJIMA.
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
R. K. Kawaratani, and S. Fujita.
Atmospheric Environment ATENBP, Vol. 24A, No. 6, p 1487-1492, June 1990. 4 fig, 2 tab, 23 ref.

Descriptors: *Acid rain, *Ash, *Chemistry of precipitation, *Path of pollutants, *Sulfates, *Volcanoes, Air pollution, Aluminum, Chlorides, Fluorides, Gases, Ions.

Wet deposition of soluble materials was monitored for a 7-month period in the vicinity of Mount Sakurajima, which has been very active since 1955. Data obtained for the ionic composition of samples were used as a basis for considering the scavenging of volcanic emissions by precipitation. Precipitation samples with pH <4 were often collected in the vicinity of Mount Sakurajima during the course of the study. HCl, H2SO4 and HF were the primary contributors to the acidity of precipitation. The mole ratio of exCl(-)/exSO4(--) in precipitation was several times that of volcanic ash in the vicinity of the volcano and declined with distance from the volcano. Although most of the S in volcanic emissions is in the form of SO2, relatively little of this is washed out by precipitation in the immediate vicinity of the volcano. The deposition of S in the vicinity of the volcano can be adequately accounted for by assuming the scavenging of SO4(--) particles despite the relatively small share of total atmospheric S loading of particulate SO4(--) in the vicinity of Mount Sakurajima. (Author's abstract)
W91-00669

ORIGIN OF SOLUBLE CHEMICAL SPECIES IN BULK PRECIPITATION COLLECTED IN TOKYO, JAPAN: STATISTICAL EVALUATION OF SOURCE MATERIALS.
Tokyo Inst. of Tech. (Japan). Dept. of Environmental Chemistry and Engineering.
M. Tsurumi, A. Takahashi, and M. Ichikuni.
Atmospheric Environment ATENBP, Vol. 24A, No. 6, p 1493-1500, June 1990. 6 fig, 4 tab, 14 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Japan, *Mathematical models, *Path of pollutants, *Solutes, Air pollution, Anions, Cations, Inorganic acids, Sea breezes, Seasonal variation, Sulfates, Water pollution sources.

An iterative least-squares method with a receptor model was applied to data on precipitation samples collected at 23 points in suburban Tokyo, and the number and composition of the source materials were determined. Thirty-nine monthly bulk precipitation samples were collected in the spring and summer of 1987 from the hilly and mountainous area of Tokyo and analyzed for Na(+), K(+), NH4(+), Mg(++), Ca(++), F(-), Cl(-), NO3(-), SO4(--) and Br(-) by atomic absorption spectrometry and ion chromatography. The pH of the samples was also measured. A multivariate ion balance approach showed that the solutes in the precipitation were derived from just three major sources: sea salt, acid substance (a mixture of 53% HNO3, 39% H2SO4 and 8% HCl in equivalent) and CaSO4. The contributions of each source to the precipitation were calculated for every sampling site. Variations of the contributions of the three source materials explained the seasonal differences in the ion fluxes in spring and summer. In summer, the sea salt contribution decreased steeply with increasing distance from the coast, while the CaSO4 contribution slightly increased. The contribution of the acid substance slowly decreased with the distance in summer. The decreasing rate of the acid substance was lower than that of the sea salt. The difference in variation of these source contributions suggests that acid substance is transported over a longer distance than sea salt. In spring, contributions of the three source materials are relatively constant in every sampling site. The contribution of sea salt is higher in spring than that in summer. The difference in the contributions of each source between the two seasons was due to local prevailing wind directions in these seasons. In Tokyo, the southeasterly wind is predominant in summer, while the wind direction is variable in spring. (Geiger-PTT)
W91-00670

MESOSCALE MODELING OF ACIDITY PRODUCTION IN OROGRAPHIC CLOUDS AND RAIN.
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. Associe de Meteorologie Physique.
N. Chaumerliac, E. Richard, and R. Rosset.
Atmospheric Environment ATENBP, Vol. 24A, No. 6, p 1573-1584, June 1990. 10 fig, 2 tab,, 17 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Cloud chemistry, *Model studies, *Orographic precipitation, *Sulfates, Advection, Aerosols, Air pollution, Nucleation, Path of pollutants.

The two-dimensional version of a mesoscale meteorological model is applied to the removal of soluble and reactive species by orographically forced clouds and precipitation. The model includes both SO4(--) and acidity productions within typical maritime clouds. A quasi-spectral microphysical scheme allows for a detailed description of the partitioning of different constituents between air, cloud and rain. Model results indicate that this partitioning is influenced by the solubility and the reactivity of the species and also by microphysical processes. The sharing of dissolved species between cloud and rain is found to be different upwind and downwind from the mountain top, leading to higher acidity in rain downstream. Replenishment of new material into the cloud through advection, aerosol load through nucleation, chemical factors and microphysical processes all compete to affect the resultant acidity in cloud-water and rain-water. Model estimates for these overlying processes suggest that interaction between dynamics, microphysics and chemistry must be well represented to predict cloud and rain compositions. (Author's abstract)
W91-00671

LIMNOLOGICAL STUDIES OF FOUR POLLUTED PONDS IN AND AROUND DHAKA CITY WITH REFERENCE TO INDICATOR SPECIES.
Dacca Univ. (Bangladesh). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W91-00672

RESISTANCE TO ANTIBIOTICS AND HEAVY METALS OF PSEUDOMONAS AERUGINOSA ISOLATED FROM NATURAL WATERS.
Malaga Univ. (Spain). Facultad de Ciencias.
For primary bibliographic entry see Field 5C.
W91-00698

HEAVY METALS DISTRIBUTION AND ENRICHMENT IN THE SEDIMENTS OF SOUTHERN EAST COAST OF INDIA.
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
V. Subramanian, and G. Mohanachandran.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 324-330, July 1990. 3 fig, 2 tab, 24 ref.

Descriptors: *Coastal waters, *Heavy metals, *India, *Path of pollutants, *River systems, *Sediment chemistry, Cadmium, Chromium, Copper, Geochemistry, Iron, Manganese, Mercury, Water pollution, Zinc.

Fractionation of heavy metals occurs predominantly in the solid phase during transport processes in river systems. Studies of iron, manganese, copper, chromium, zinc, mercury, and cadmium were carried out on thirty-six samples of bed sediments collected from different parts of the southeast coast of India, including coastal, river and river mouth regions. Data indicate that the concentration of all the metals considered decreases towards the coast. For example, lead concentration at 65 km from the coast has an average value of 50 ppm; at 25 km from the coast, 20 ppm; and along the coast, 5-10 ppm. Grain size is a major controlling factor in the distribution of heavy metals in the coastal sediments. Geoaccumulation indices calculated for these metals show that cadmium is the most enriched metal, followed by lead. Other metals are at background concentrations. This high level of cadmium indicates that the area appears to be contaminated due to non-natural sources, such as pollution. (Author's abstract)
W91-00701

BEACH TAR CONTAMINATION IN JAMAICA.
University of the West Indies, Kingston (Jamaica). Dept. of Zoology.
M. A. J. Jones, and P. R. Bacon.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 331-334, July 1990. 1 fig, 1 tab, 13 ref.

Descriptors: *Beach contamination, *Coasts, *Jamaica, *Path of pollutants, *Tar, Hydrocarbons, Monitoring.

Since 1979 the Intergovermental Oceanographic Commission's Regional commission for the Caribbean and Adjacent Regions has conducted a monitoring program for petroleum pollution in the wider Caribbean area. One of the parameters measured in this study was stranded beach tar. The quantity of stranded beach tar on Jamaican beaches was measured by collecting beach tar residues from twenty-nine beach stations around the Jamaican coast on monthly visits for thirteen months. Stranded beach tar was found to be very persistent. The east coast and Kingston Harbor Area are subjected to constant relatively large amounts of fresh tar; the north coast, although receiving small amounts of fresh tar, appeared to have been impacted by a particular incident about two years ago, giving highly skewed distributions; the west coast is virtually clean and the south coast (with the exception of the Kingston Harbor Area) showed no evidence of stranded beach tar pollution at any time during the study. (Author's abstract)
W91-00702

USING SEABIRDS TO MONITOR MERCURY IN MARINE ENVIRONMENTS: THE VALIDITY OF CONVERSION RATIOS FOR TISSUE COMPARISONS.
Glasgow Univ. (Scotland). Dept. of Zoology.
D. R. Thompson, F. M. Stewart, and R. W. Furness.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 339-342, July 1990. 1 tab, 21 ref. NERC Grants GR3/7411 and GT4/86/AL5/15.

Descriptors: *Animal metabolism, *Bioaccumulation, *Bioindicators, *Mercury, *Water birds, Animal physiology, Conversion ratio, Marine environment.

The '7:3:1 rule' for converting mercury concentrations between feather, liver, and muscle tissue was evaluated by measuring total and methyl mercury levels in liver, muscle, and body feathers of a range of seabird species. Mean mercury concentrations were used to calculate feather-liver (both total and methyl) and feather-muscle ratios, results obtained being compared with the predicted values of 2.3 and 7.0. Feather-liver ratios approximated 2.3 when liver methyl mercury concentrations were considered, but elevated inorganic mercury concentrations in the livers of some species resulted in greater reduced feather-liver ratios for total mercury. Feather-muscle ratios varied from 3.8 to 15.3. Factors likely affect the values of feather-liver and feather-muscle mercury concentration ratios, such as the predominant form of mercury present in the liver tissue, sampling date relative to the stage of the molt sequence and types of feather used for analysis, preclude the 7:3:1 conversion ration being used without a measure of caution. (Author's abstract)
W91-00704

DETERMINATION OF THE ENVIRONMENTAL CAPACITY OF HAIFA BAY WITH RESPECT TO THE INPUT OF MERCURY.
National Inst. of Oceanography, Haifa (Israel).
M. D. Krom, H. Hornung, and Y. Cohen.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 349-354, July 1990. 8 fig, 1 tab, 23 ref.

Descriptors: *Bioaccumulation, *Haifa Bay, *Israel, *Mercury, *Path of pollutants, Fish physiology, Regression analysis, Waste disposal.

The Environmental Capacity of Haifa Bay, on the Mediterranean shoreline of Israel, has been estimated with respect to inputs of mercury. From 1956 to 1975, a chlor-alkali plant discharged effluent to the Bay without pollution abatement measures with a maximum discharge of 1900 kg/yr in 1975. From 1976 the input flux was drastically reduced until in 1981 the present level of 35 kg/yr was reached. Diplodus sargus (porgy) is a commercially important fish, chosen as a critical path to man. Mercury accumulates as a function of weight (age). A series of linear regressions of mercury content versus weight for the size range 40 to 175 g were calculated. Both the slopes of the regression lines of mercury content (measures of the rate of bioaccumulation), and the calculated concentrations in a 'standard 150 g fish' decreased with time in the polluted area, although the present level of 0.6 ppm is still significantly greater than the levels of 0.15 ppm in adjacent uncontaminated areas, an increase attributed to elevated levels of mercury in the sediment and benthic food chain. A simple linear regression was made between the mercury content in the muscle of Diplodus sargus and the mercury input to Haifa Bay over the preceding three years (the estimated age of a 150 g fish). If the unacceptable level of mercury is 1 ppm, then the level of mercury in the Bay is now acceptable; if the action level is 0.3 ppm, then despite the installation of pollution abatement measures, the mercury levels in the Bay are still considered to be unacceptably high. The Environmental Capacity concept is very useful for designing scientific studies for examining the problems of waste disposal in the sea. (Author's abstract)
W91-00706

SOME PRELIMINARY DATA ON THE NUTRIENT INFLUX INTO THE WESTERN BLACK SEA.
Water Management Office, Constanta (Romania).
R. Chirea, and M.-T. Gomoiu.
Cercetari Marine: Recherches Marines CMARDQ, Vol. 19, p 171-187, 1986. 3 fig, 4 tab, 18 ref.

Descriptors: *Black Sea, *Danube River, *Eutrophication, *Littoral zone, *Nutrients, *Water pollution sources, Ammonium, Nitrates, Nitrites, Nonpoint pollution sources, Path of pollutants, Phosphorus, Pollution load, Romania, Waste disposal.

The influx of ammonium, nitrates, nitrites, and phosphorus to the Romanian littoral waters and the contribution of various nutrient sources to Black Sea waters were estimated on the basis of 1600 analyses carried out periodically between 1976 and 1985. Based on this preliminary examination of the contribution of the Danube River and the southern Romanian effluents to the enrichment of Black Sea waters with ammonium, nitrite, nitrate, and phosphate, several conclusions were drawn. Between 1976 and 1985, an average of 214 cu km/yr was discharged into Romanian littoral waters, of which 99.9745% came from the Danube and only 0.0255% from the effluents. In 10 yr, freshwater discharges carried into the marine environment 17.59 million tons of nutrients, of which about 2.7% were ammonium, 1.2% were nitrite, 93.6% were nitrate, and 2.4% phosphate phosphorus. Great variability was seen in the concentrations of the nutrients analyzed, but generally the mean values were higher in the wastewaters than in Danube water. Compared to the situation in the 1960s, the concentrations of nutrients in the Danube are 1.2 times as great for ammonium, 1.7 times as great for nitrates, 1.5 times as great for phosphorus, implying that nutrient discharges into the Black Sea from this source have increased. Several measures are recommended for dealing with eutrophication, including: instituting wastewater filtration and nutrient extraction; discharge of secondary-treatment wastewaters offshore, far from beaches used by tourists; deployment of artificial reefs around discharge areas; and programs to control discharge of effluents into coastal ecosystems. (Rochester-PTT)
W91-00712

EFFECTIVE MODELLING OF A MAJOR INLAND OIL SPILL ON THE OHIO RIVER.
Ohio State Univ., Columbus. School of Natural Resources.
J. K. Cronk, W. J. Mitsch, and R. M. Sykes.
Ecological Modelling ECMODT, Vol. 51, No. 3/4, p 161-192, June 1990. 12 fig, 2 tab, 37 ref.

Descriptors: *Model studies, *Monongahela River, *Ohio River, *Oil spills, *Path of pollutants, Ecological effects, Performance evaluation, Simulation, Storms.

A model of a large (2700 cu m) inland oil spill on the Monongahela/Ohio River system, on 2 January 1988 is developed to estimate the fate and

transport time of the oil for 600 km downstream. The emphasis is on developing an effective modeling procedure that balances accuracy with simplicity, is user friendly, and is easily applicable to future spills. Model calibration with oil concentration data suggests that loss of oil due to sedimentation was important. After calibration, the model estimates that 1400 cu m or 52% of the spilled oil ended up in the sediments, most of it in the first few reservoir pools along the river. Both the model and field data agree on similar peak concentrations of oil of between 1.0 and 2.5 ppm (by volume) in the river pools between 130 and 240 km downstream of the spill. The model was further validated by comparing the output with the actual time of travel of the oil spill. Other simulations include the use of resuspension of oil during high flow conditions and an investigation of the role of storms on the time of travel of the oil spill. Model results suggest that the location of the most significant ecological impact was not at the spill site but was between 130 and 240 km further downstream because of the greater exposure time there. (Author's abstract)
W91-00714

TRANSFORMATION AND TRANSPORT OF AMMONIUM NITROGEN IN A FLOODED ORGANIC SOIL.
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
K. R. Reddy, P. S. C. Rao, and R. E. Jessup.
Ecological Modelling ECMODT, Vol. 51, No. 3/4, p 205-216, June 1990. 5 fig, 2 tab, 17 ref.

Descriptors: *Ammonium, *Flooding, *Nitrogen, *Nutrient transport, *Path of pollutants, *Soil chemistry, *Soil water, *Water pollution sources, Isotope studies, Light effects, Microcosms, Model studies, Organic matter, Simulation.

Outdoor microcosms were used to determine inorganic-N fluxes from a flooded organic soil to the overlying water column. In the two experimental systems evaluated, the floodwater was either exposed to daylight or was covered to block light entry. During the 217-day study, the estimated inorganic-N flux from the soil to the overlying water was in the range of 220-330 kg N/ha/yr. About 20-30% of the added 15NH4-N was lost from the soil via denitrification and NH3 volatilization. Losses of NH4-N were generally higher when the floodwater surface was exposed to light. Measured changes in porewater NH4(+) concentration profiles in the soil agreed with the trends predicted by a simulation model that coupled the dynamics of N transport and transformations in both the soil and the floodwater. (Author's abstract)
W91-00716

USE OF CHLOROFORM IN SEDIMENT TRAPS: CAUTION ADVISED.
Bergen Univ. (Norway). Dept. of Marine Biology.
For primary bibliographic entry see Field 7B.
W91-00731

BACTERIAL REGENERATION OF AMMONIUM AND PHOSPHATE AS AFFECTED BY THE CARBON:NITROGEN:PHOSPHORUS RATIO OF ORGANIC SUBSTRATES.
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
Y. Tezuka.
Microbial Ecology MCBEBU, Vol. 19, No. 3, p 227-238, May/June 1990. 7 fig, 3 tab, 23 ref.

Descriptors: *Bacteria, *Culturing techniques, *Cycling nutrients, *Freshwater, *Limnology, Ammonium, Biomass, Carbon, Nitrogen, Nutrient ratio, Organic matter, Phosphates, Phosphorus.

The effect of the carbon:nitrogen:phosphorus (C:N:P) ratio of organic substrates on the regeneration of ammonium and phosphate was investigated by growing natural assemblages of freshwater bacteria in mineral media supplemented with simple organic C, N, and P sources (glucose, asparagine, and sodium glycerophosphate, respectively) to give 25 different substrate C:N:P ratios. Both ammonium and phosphate were regenerated when C:N and N:P atomic ratios of organic substrates were < or = 10:1 and < or = 16:1, respectively. Only ammonium was regenerated when C:N and N:P ratios were < or = 10:1 and > or = 10-20:1, respectively. On the other hand, neither ammonium nor phosphate was regenerated when C:N and N:P ratios were > or = 15:1 and > or = 5:1, respectively. In no case was phosphate alone regenerated. As bacteria were able to alter the C:N:P ratio of their biomass, the growth yield of bacteria appeared primarily dependent on the substrate carbon concentration, irrespective of a wide variation in the substrate C:N:P ratio. (Author's abstract)
W91-00732

LONG-TERM SURVIVAL OF AND PLASMID STABILITY IN PSEUDOMONAS AND KLEBSIELLA SPECIES AND THE APPEARANCE OF NONCULTURABLE CELLS IN AGRICULTURAL DRAINAGE WATER.
Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen (Netherlands).
L. S. van Overbeek, J. D. van Elsas, J. T. Trevors, and M. E. Starodub.
Microbial Ecology MCBEBU, Vol. 19, No. 3, p 239-249, May/June 1990. 1 fig, 3 tab, 25 ref.

Descriptors: *Agricultural runoff, *Bacteria, *Fate of pollutants, *Klebsiella, *Path of pollutants, *Pseudomonas, Competition, Culturing techniques, Ecology, Isotope studies, Microorganisms, Phosphorus isotopes, Plasmids, Tracers.

One year after introduction into agricultural drainage water, Pseudomonas fluorescens R2f (RP4), Pseudomonas putida CYM318 (pRK2501), and Klebsiella aerogenes NCTC418 (pBR322) could be recovered on agar media. Survival of these introduced strains depended on competition with the indigenous microflora, the presence of nutrients, and the availability of air. In contrast to K. aerogenes NCTC418 (pBR322), both Pseudomonas species lost their plasmids, as indicated by the consistently lower colony counts on selective media compared with the counts on nonselective media. The plasmid loss did not depend on nutrient status and oxygen supply. P. fluorescens R2f cells could be detected with the immunofluorescence (IF) technique. Total cell counts determined by IF were consistently higher than corresponding colony counts. Even in samples where no colonies were recovered, R2f cells could be detected by IF. This indicated the occurrence of nonculturable R2f cells in drainage water. Homology with 32P-labeled plasmid RP4 DNA was found in several drainage water samples that originally received P. fluorescens R2f (RP4) by using the cell suspension filter hybridization technique. P. putida CYM318 and K. aerogenes NCTC418 cells also could be detected in sterile drainage water samples, after nonspecific staining with fluorescein isothiocyanate. Cell counts of both strains were consistently higher than corresponding plate counts. (Author's abstract)
W91-00733

WATER QUALITY IN THE BARYCZ RIVER AND ITS TRIBUTARIES WITHIN THE AREA OF THE LOW SILESIAN COMMERCIAL FISHERY FARM IN MILICZ (JAKOSC WODY RZEKI BARYCZY I JEJ DOPLYWOW NA OBSAZARZE DOLNOSLASKIEGO KOMBINATU RYBACKIEGO).
Akademia Rolnicza, Wroclaw (Poland). Dept. of Limnology.
J. Marek, and E. Szulkowska-Wojaczek.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 2, p 23-40, 1990. 2 fig, 2 tab, 15 ref. English summary.

Descriptors: *Agricultural runoff, *Aquaculture, *Barycz River, *Fish ponds, *Nonpoint pollution sources, *Poland, *Water pollution, Biological oxygen demand, Carp, Conductivity, Heavy metals, Hydrogen ion concentration, Mercury, Nutrients, Salinity, Water temperature, Zinc.

Chemical composition and physical properties of river water used for filling carp ponds was investigated. Samples from numerous stations in the Barycz River catchment area were collected in the years 1981 (36), 1982 (114), 1983 (76), and 1984 (57). Parameters investigated were water temperature, dissolved oxygen, phosphates, ammonia, nitrates, potassium, sodium, BOD5, color, total hardness, calcium, magnesium, sulfates, chloride, pH, conductivity, iron, manganese, copper, zinc, cadmium, and mercury. The river waters varied considerably in terms of their chemical and physical properties. Heavy metals were the most frequent cause of low water quality. Permissible levels were exceeded for Zn (up to 0.530 mg/cu dm) and mercury (up to 0.0153 mg/cu dm). Comparative studies conducted during prolonged drought and after heavy rains revealed that surface runoff from agricultural catchments carried a considerable load of pollutants. Content of the basic nutrients, sulfates, calcium, magnesium, and manganese increased considerably after heavy rains in rivers with no point sources of pollution. (Rochester-PTT)
W91-00734

MICROBIOLOGICAL INVESTIGATIONS OF LAKE NIEGOCIN (BADANIA MIKROBIOLOGICZNE JEZIORA NIEGOCIN).
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Zaklad Mikrobiologii Sanitarnej.
S. Niewolak.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 1, p 109-130, 1990. 1 fig, 7 tab, 15 ref. English summary.

Descriptors: *Aquatic bacteria, *Lakes, *Limnology, *Poland, *Water pollution sources, Actinomycetes, Correlation analysis, Fungi, Heterotrophic bacteria, Lake Niegocin, Path of pollutants, Physicochemical properties, Spatial distribution, Statistical analysis, Temporal distribution, Water circulation, Water pollution.

The results of investigations on numbers of bacterioplankton, heterotrophic bacteria, Actinomycetes and filamentous fungi in the waters of Lake Niegocin were analyzed. Samples were taken at six sites located at the most characteristic points of the lake. The investigations were carried out in annual cycles in 1978-1979. Statistical analyses were made including determination of correlation coefficients between the above mentioned microorganisms and selected physico-chemical indicators, and also of the bacteriological pollution level of Lake Niegocin waters. Numbers of bacterioplankton, heterotrophic bacteria and fungi, especially of yeasts (Actinomycetes were found only rarely and as single specimens) indicated a high level of pollution of the northern part of Lake Niegocin in the Gizycko region at sites located in the vicinity of communal and industrial sewage outflow, around Grajewska-Kepa Island, and the municipal baths. Clean or only slightly polluted water was noted in the southern part of the lakes in the region of Rydzewo and Bogaczewo, and periodically higher pollution levels in the region around Wilkasy. During the latter part of summer stagnation set in, and only bacterioplankton and heterotrophic bacteria occured in the metalimnion of only of the sites examined. The period of autumnal circulation was characterized by a somewhat more uniform distribution of bacterioplankton, heterotrophic bacteria and yeasts in the water, with few Actinomycetes and filamentous fungi. No highly significant correlation was noted between the number of the microorganisms under study in the water in Lake Niegocin, and its temperature, turbidity, electrolytic conductivity, suspended matter, oxygen content, oxidability, biological oxygen demand, nitrate, phosphate, and nitrate:phosphate ratio. Correlations were more frequently noted between total numbers of bacteria determined on broth-agar at temperatures of 20 C and 37 C and total coliforms, and also between total numbers of fecal coliforms (Escherichia coli) and numbers of fecal streptococci. (Author's abstract)
W91-00787

RADIOACTIVITY LEVEL OF BLACK SEA MARINE ALGAE BEFORE AND AFTER THE CHERNOBYL ACCIDENT.

Istanbul Univ. (Turkey). Dept. of Pharmaceutical Technology.
K. C. Guven, M. Plevneli, E. Cevher, S. Topcuoglu, and N. Kose.
Toxicological and Environmental Chemistry TXECBP, Vol. 27, No. 4, p 297-302, 1990. 2 fig, 1 tab, 11 ref.

Descriptors: *Algal physiology, *Chernobyl, *Path of pollutants, *Radioactivity, *Turkey, Bioaccumulation, Bioindicators, Chlorophyta.

Radioactive pollution of the algae collected at Sile and Sinop on the Black Sea coast of Turkey was investigated after the Chernobyl accident. The findings were compared with the results on the algae which had been collected before the accident. The highest accumulation of cesium-137 radionuclide was found in Chaetomorpha linum a green alga. The radioactivity reached a peak in all samples collected soon after the accident in 1986 and gradually diminished in the samples of 1987 and 1988. These results supported the hypothesis that measurements of radioactivity in marine algae could conveniently be taken as an indicator for determining radioactive pollution. (Author's abstract)
W91-00796

DISTRIBUTION AND CORRELATION OF ELEMENTS IN WATERS, SUSPENSIONS, SEDIMENTS, AND MARINE ORGANISMS FROM THE BLACK SEA.
Bulgarian Academy of Sciences, Varna. Inst. of Oceanography.
For primary bibliographic entry see Field 5A.
W91-00797

WATER MASSES AND EUTROPHICATION IN A GREEK ANOXIC MARINE BAY.
National Centre for Marine Research, Athens (Greece).
N. Friligos, and S. Barbetseas.
Toxicological and Environmental Chemistry TXECBP, Vol. 28, No. 1, p 11-23, 1990. 6 fig, 2 tab, 17 ref.

Descriptors: *Cycling nutrients, *Eutrophication, *Greece, *Path of pollutants, *Water pollution sources, Anoxic conditions, Destratification, Nutrient removal, Nutrient transport, Stratification, Water masses.

Water masses and nutrient circulation were studied during 1985 in the Elefsis Bay, an anoxic basin in the Saronikos Gulf. The water of Elefsis Bay was found to be well mixed during the winter, a condition resulting from surface heavy water formation and mechanical mixing. The greatest variations were found at the east and west ends where advective fluxes of warmer outside water generated gradients. During the spring, surface heating and reduced mechanical mixing permit the development of a stratification which effectively isolates the lower layers from anything but small diffusive exchanges with the upper layers. Destratification in Elefsis Bay due to winter cooling, heavy water formation, and mechanical mixing produces a homogeneous water column that is moderately stratified during the summer as a result of surface heating and reduced mechanical mixing. Nutrients, such as phosphorus and nitrogen, are important properties of water and sediment quality of marine environments. In Elefsis Bay, the concentrations of nutrients varied seasonally with destratification redistributing ammonium, phosphate, and silicate that was regenerated by the organic matter as well as oxygen from the surface. This redistribution has significant implications for nutrient cycles and organism distribution in the Bay. (Korn-PTT)
W91-00798

URBAN STORM-INDUCED DISCHARGE IMPACTS.
Environmental Protection Agency, Edison, NJ. Storm and Combined Sewer Technology Branch.
For primary bibliographic entry see Field 4A.
W91-00803

DISTRIBUTION AND TRANSPORT OF SEDIMENT-BOUND METAL CONTAMINANTS IN THE RIO GRANDE DE TARCOLES, COSTA RICA (CENTRAL AMERICA).
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W91-00804

BIODEGRADATION KINETICS OF SUBSTITUTED PHENOLICS: DEMONSTRATIONS OF A PROTOCOL BASED ON ELECTROLYTIC RESPIROMETRY.
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
S. C. Brown, C. P. Leslie Grady, and H. H. Tabak.
Water Research WATRAG, Vol. 24, No. 7, p 853-861, July 1990. 6 fig, 1 tab, 19 ref. EPA Cooperative Agreement CR-813382-01-0.

Descriptors: *Biodegradation, *Fate of pollutants, *Kinetics, *Phenols, *Respirometry, *Substrates, *Wastewater treatment, Electrolytic respirometry, Experimental design, Nonlinear curve fitting, Oxygen uptake, Spreadsheets.

Biodegradation plays an important role in the fate of synthetic organic chemicals in both natural and engineered environments. As a consequence, prediction of the fate of such chemicals requires quantification of their biodegradation rates in the form of intrinsic kinetic parameters that can be used in mass balance equations. An easily obtained determination of the parameter value describing biodegradation is possible using oxygen uptake data collected automatically from batch reactors using electrolytic respirometry. Data from electrolytic respirometers were used to evaluate the kinetics of biodegradation of phenol, 2-chlorophenol (2-CP), 4-chlorophenol (4-CP), m-cresol, 2,4-dimethylphenol (2,4-DMP), 2,4-dinitrophenol (2,4-DNP), and 4-nitrophenol (4-NP) through the use of spreadsheets and nonlinear curve-fitting. The parameter estimates obtained are intrinsic in the sense that they are not dependent on the substrate concentration or the reactor system employed. However, the parameters are a function of the biomass used to determine them. The protocol is capable of detecting substrate inhibition and of quantifying the parameters describing it. In addition, the protocol is capable of detecting product inhibition. Of the phenols considered in this study, 4-chlorophenol exhibited substrate inhibition kinetics and 2,4-dinitrophenol exhibited product inhibition kinetics. The others could be characterized by Monod kinetics. Finally, based on the maximum specific growth rate (mu), the relative biodegradability of the compounds was phenol > 4-NP, 4-CP > m-cresol > 2,4-DMP > 2,4-DNP > 2-CP. (Korn-PTT)
W91-00809

ACTIVITY AND ADAPTATION OF NITRILOTRIACETATE (NTA)-DEGRADING BACTERIA: FIELD AND LABORATORY STUDIES.
Montana State Univ., Bozeman. Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W91-00811

ISOLATION OF DISSOLVED ORGANIC MATTER FROM THE SUWANNEE RIVER USING REVERSE OSMOSIS.
Georgia Inst. of Tech., Atlanta. School of Earth and Atmospheric Sciences.
S. M. Serkiz, and E. M. Perdue.
Water Research WATRAG, Vol. 24, No. 7, p 911-916, July 1990. 1 fig, 1 tab, 22 ref. EPA Cooperative Agreement No. CR813471-01.

Descriptors: *Georgia, *Humic substances, *Organic matter, *Pollutant identification, *Reverse osmosis, *Water analysis, Cation exchange, Data acquisition, Dissolved organic matter, Experimental design, Rivers, Suwannee River, Water chemistry.

Because dissolved organic matter (DOM) appears to play such an important biochemical and geochemical role in aquatic ecosystems, there is considerable interest in incorporating its chemical properties into predictive models of kinetic and equilibrium processes. Characterization of DOM is generally conducted using samples that have been isolated from the aquatic environment. However, it has been suggested that some DOM samples are highly fractionated and remarkably uniform and devoid of site-specific information that might be present in the original water samples. It has been recommended that efforts should be increased to isolate a higher percentage of DOM, so that the isolated DOM will be more representative of natural DOM. A portable reverse osmosis (RO) system was constructed and used to concentrate DOM from the Suwannee River in southeastern Georgia. Using this RO system, 150-180 l/h of river water could be processed with 90% recovery of DOM. After further cation exchange and lyophilization of the concentrated river water samples, large quantities of low-ash freeze-dried products were isolated. This RO method is highly recommended for concentration of DOM in fresh waters because; (1) a very high percentage of DOM is recovered, which indicates minimal fractionation of the original sample; and (2) the process is quite rapid, which permits large quantities of DOM to be concentrated in a reasonable length of time. (Author's abstract)
W91-00816

DEGRADATION OF POLYPHENOLS IN FIVE PLANT SPECIES IN THE AQUATIC ENVIRONMENT (DEGRADACAO DE PLOIFENOIS EM CINCO ESPECIES VEGETAIS EM AMBIENTES AQUATICOS).
Convenio Eletronorte/CNPq/INPA, Brazil.
For primary bibliographic entry see Field 2H.
W91-00821

BIOMONITORING OF CHEMICALS ON TROPICAL ECOSYSTEMS.
Universitaet des Saarlandes, Saarbruecken (Germany, F.R.). Inst. fuer Biogeographie.
P. Muller.
Amazoniana AMAZAP, Vol. 11, No. 1, p 71-89, 1989. 7 fig, 6 tab, 7 ref.

Descriptors: *Bioindicators, *Biomonitoring, *Environmental effects, *Monitoring, *Pesticides, *Tropical regions, Africa, Europe, Herbicides, Insecticides, Land use, Pollutants, South America.

In the absence of effective biomonitoring, detection of serious environmental contamination and threats to human health caused by chemical pollutants may occur only after critical and irreversible damage had been done. Between 1976 and 1989 the ecosystematic effects caused by various herbicides and insecticides tropical South America, Africa and Europe were analyzed. The regenerative power of the tropical ecosystems, after having been treated with insecticides, does not only depend on the type of pesticide or its formulation and concentration, but also on the ecophysiological capacity of different organisms in the tropical food chains. Experience in that tropical regions studied has proved that the application of chemicals does not represent a serious environmental problem, provided the chemical inputs on the ecosystems have already been evaluated, and the whole procedure and organization are carried out in a professional manner. Concerning the elimination of pests, it has been observed that various forms of land utilization in the tropics have a much more adverse effect than the effects induced by pesticide usage. (Author's abstract)
W91-00823

INCIDENCE OF VIBRIO PARAHAEMOLYTICUS IN U.S. COASTAL WATERS AND OYSTERS.
Food and Drug Administration, Dauphin Island, AL. Fishery Research Branch.
A. DePaola, L. H. Hopkins, J. T. Peeler, B. Wentz, and R. M. McPhearson.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2299-2302, August 1990. 4 tab, 27 ref.

Descriptors: *Bioaccumulation, *Enteric bacteria, *Oysters, *Path of pollutants, *Shellfish, *Vibrio, Alabama, California, Fecal coliforms, Florida, Louisiana, Rhode Island, Seasonal variation, Seawater, South Carolina, Texas, Virginia, Washington, Water temperature.

Vibrio parahaemolyticus is an enteric pathogen transmitted to humans primarily through consumption of raw or mishandled seafood. Oyster and seawater samples were collected seasonally from May 1984 through April 1985 from shellfish-growing areas in Washington, California, Texas, Louisiana, Alabama, Florida, South Carolina, Virginia, and Rhode Island which had been designated as approved or prohibited by the National Shellfish Sanitation Program. Fecal coliform counts, aerobic plate counts, and Vibrio parahaemolyticus densities were determined for the samples. Mean V. parahaemolyticus density was more than 100 times greater in oysters than in water, whereas density of fecal coliforms was approximately 10 times higher in oysters. Seasonal and geographical distributions of V. parahaemolyticus were related to water temperature, with highest densities in samples collected in the spring and the summer along the Gulf coast. The synthetic DNA probe for thermostable direct hemolysin hybridized with 2 of 50 isolates, one of which was positive by the Kanagawa test. (Author's abstract)
W91-00825

DECHLORINATION OF FOUR COMMERCIAL POLYCHLORINATED BIPHENYL MIXTURES (AROCLORS) BY ANAEROBIC MICROORGANISMS FROM SEDIMENTS.
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
J. F. Quensen, S. A. Boyd, and J. M. Tiedje.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2360-2369, August 1990. 8 fig, 3 tab, 14 ref.

Descriptors: *Biodegradation, *Dehalogenation, *Fate of pollutants, *Microbial degradation, *Polychlorinated biphenyls, *Sediments, Anaerobic bacteria, Aroclors, Hudson River, Massachusetts, Microorganisms, New York, Sediment contamination, Silver Lake.

The rate, extent, and patten of dechlorination of four Aroclors by inocula prepared from two polychlorinated biphenyl (PCB)-contaminated sediments were compared. The four mixtures used, Aroclors 1242, 1248, 1254, and 1260, averaged approximately three, four, five, and six chlorines, respectively, per biphenyl molecule. All four Aroclors were dechlorinated with the loss of meta plus para chlorines ranging from 15 to 85%. Microorganisms from an Aroclor 1242-contaminated site in the upper Hudson River dechlorinated Aroclor 1242 to a greater extent than did microorganisms from Aroclor 1260-contaminated sediments from Silver Lake, Mass. The Silver Lake inoculum dechlorinated Aroclor 1260 more rapidly than the Hudson River inoculum did and showed a preferential removal of meta chlorines. For each inoculum the rate and extent of dechlorination tended to decrease as the degree of chlorination of the Aroclor increased, especially for Aroclor 1260. The maximal observed dechlorination rates were 0.3, 0.3, and 0.2 microg-atoms of Cl removed per g of sediment per week for Aroclors 1242, 1248, and 1254, respectively. The maximal observed dechlorination rates for Hudson River and Silver Lake organisms for Aroclor 1260 were 0.04 and 0.21 microg-atoms of Cl removed per g of sediment per week, respectively. The dechlorination patterns obtained suggested that the Hudson River microorganisms were more capable than the Silver Lake organisms of removing the last para chlorine. These results suggest that there are different PCB-dechlorinating microorganisms at different sites, with characteristic specificities for PCB dechlorination. The dechloroination of Arochlor 1260 had not been demonstrated previously. It indicates that more PCB congeners are potentially degradable by a sequential anaerobic-aerobic treatment system. (Author's abstract)
W91-00827

DETECTION OF VIBRIO CHOLERAE O1 IN THE AQUATIC ENVIRONMENT BY FLUORESCENT-MONOCLONAL ANTIBODY AND CULTURE METHODS.
International Centre for Diarrheal Disease Research, Dacca (Bangladesh).
For primary bibliographic entry see Field 5A.
W91-00828

IRON-BINDING COMPOUNDS AND RELATED OUTER MEMBRANE PROTEINS IN VIBRIO CHOLERAE NON-O1 STRAINS FROM AQUATIC ENVIRONMENTS.
Valencia Univ. (Spain). Faculty of Physics.
C. Amaro, R. Aznar, E. Alcaide, and M. L. Lemos.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2410-2416, August 1990. 1 fig, 4 tab, 41 ref.

Descriptors: *Aquatic bacteria, *Bacterial physiology, *Iron uptake, *Nutrients, *Pathogenic bacteria, *Vibrio, Aquatic populations, Bacterial analysis, Microbiological studies.

A total of 156 strains of Vibrio cholerae non-O1 from aquatic origins were examined for the presence of iron uptake mechanisms and compared with O1 strains and other Vibrio species. All non-O1 strains were able to grow in iron-limiting conditions, withethylenediaminedi(O-hydroxyphenylacetic acid) ranging from 20 microM to 2 mM. The production of siderophores was demonstrated by growth in chrome azurol S agar and cross-feeding assays. All strains produced phenolate-type compounds, as assessed by the chemical tests and by bioassays with Salmonella typhimurium enb-7. Some of the strains also promoted the growth of S. typhimurium enb-1 (which can use only enterobactin as a siderophore) as well as some strains of Vibrio anguillarum deficient in the anguibactin-mediated system. The chromatographic analyses and absorption spectra of siderophores extracted from culture supernatants suggest that vibriobactin may be produced by the strains examined. Some strains also produced hydroxamate-type compounds, as determined by chemical tests, and were able to promote the growth of an aerobactin-deficient strain of Escherichia coli. These results were confirmed by the absorption spectra and chromatographic analyses of the culture extracts. The synthesis of iron-regulated outer-membrane proteins in representative strains was also examined. The molecular sizes of the main induced proteins ranged from 70 to 78 kilodaltons. These results indicate that several iron uptake mechanisms which could be involved in environmental survival and pathogenicity are present in environmental V. cholerae non-O1 strains. (Author's abstract)
W91-00830

TETRACHLOROETHENE TRANSFORMATION TO TRICHLOROETHENE AND CIS-1,2-DICHLOROETHENE BY SULFATE-REDUCING ENRICHMENT CULTURES.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
D. M. Bagley, and J. M. Gossett.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2511-2516, August 1990. 3 fig, 3 tab, 27 ref. U.S. EPA Grant R-814380-.

Descriptors: *Bacteria, *Biodegradation, *Chlorinated hydrocarbons, *Cleanup, *Site remediation, *Soil treatment, *Toxicity, *Water pollution treatment, Groundwater pollution, Inhibition, Methane bacteria, Model studies, Soil contamination, Trichloroethane, Trichloroethene.

Tetrachloroethene was reductively dechlorinated to trichloroethene and cis-1,2-dichloroethene by laboratory sulfate-reducing enrichment cultures. The causative organism or group was not identified. However, tetrachloroethene was dechlorinated to trichloroethene in 50 mM bromoethane-sulfonate-inhibited enrichments and to trichloroethene and cis-1,2-dichloroethene in 3 mM fluoroacetate-inhibited enrichments. Overall transformation varied from 92% tetrachloroethene removal in 13 days to 22% removal in 65 days, depending on conditions of the inoculum, inhibitor used, and auxiliary substrate used. Neither lactate, acetate, methanol, isobutyric acid, valeric acid, isovaleric acid, hexanoic acid, succinic acid, nor hydrogen appeared directly to support tetrachloroethene dechlorination, although lactate-fed inocula demonstrated longer-term dechlorinating capability. (Author's abstract)
W91-00833

TOLERANCE OF SCAPANIA UNDULATA (L.)DUM. TO FLUORIDE.
Wroclaw Univ. (Poland). Dept. of Ecology and Nature Protection.
For primary bibliographic entry see Field 5C.
W91-00835

ATMOSPHERIC CHEMISTRY OF PEROXIDES: A REVIEW.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
D. W. Gunz, and M. R. Hoffmann.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1601-1633, July 1990. 3 fig, 3 tab, 330 ref.

Descriptors: *Acid rain, *Acidification, *Air pollution, *Atmospheric chemistry, *Hydrogen peroxide, *Literature review, *Nitric acid, *Sulfuric acid, *Water pollution sources, Chemical reactions, Cloud chemistry, Free radical reactions, Photolysis, Urban areas.

Inorganic and organic peroxides have become the focus of increased attention by atmospheric chemists during the last decade. Hydrogen peroxide serves as an important link between gas phase radicals and aqueous phase chemistry in the atmosphere. As an important aqueous phase oxidant of S(IV), H2O2 is a significant species in photochemical smog as a chain terminator and as an index of hydroperoxyl radical concentrations. Hydrogen peroxide also plays a major role in the acidification of clouds, fogs, dew, and rain. Several studies have indicated that hydrogen peroxide and organic hydroperoxides are also considered to be potent plant phototoxins. A review of ambient H2O2 maxima for the United States and Central Europe ranged from 4-5 ppb vapor (ppbv) and 200-300 microMolar in the gas and aqueous phase, respectively. There appears to be a correlation between the presence of peroxides (hydrogen and organic), photoactivity (seasonal variations, spatial and temporal variation) and photochemical smog (O3, NOx). These apparent relationships suggest that the presence of H2O2 and organic hydroperoxides in the atmosphere is linked to the chemistry of their precursors. In addition, the production of H2O2 in the gas phase is a function of light intensity and the ambient concentrations of hydrocarbons, aldehydes, CO, NO, NO2, and O3. H2O2 can be produced in situ in cloud-water droplets or on surfaces. It is generally assumed that H2O2 is formed via photochemical and thermal reactions in the gas and aqueous phases of the atmosphere. (Korn-PTT)
W91-00841

FIELD INVESTIGATIONS ON THE SNOW CHEMISTRY IN CENTRAL AND SOUTHERN CALIFORNIA-I. INORGANIC IONS AND HYDROGEN PEROXIDE.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
D. W. Gunz, and M. R. Hoffmann.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1661-1671, July 1990. 16 fig, 2 tab, 65 ref. California Air Resources Board Contract A6-185-32.

Descriptors: *Acid rain, *Hydrogen peroxide, *Organic acids, *Path of pollutants, *Snow, *Snowpack, *Water pollution sources, Air pollution, Atmospheric chemistry, Atmospheric water, California, Chemistry of precipitation, Cloud chemistry, Cloud liquid water, Inorganic snow chemistry, Precipitation, Snow sampling, Snowmelt, Sulfates, Sulfur.

In recent years the chemistry of rain, fog, and clouds along the West Coast of the United States has been the focus of increased attention. Previous research has established the role of atmospheric deposition and interception of cloudwater in forests as pathways for the introduction of acidity to these regions. Measurements of various inorganic species in snow collected in central and southern California during the winter of 1987-1988 indicate a combined influence of anthropogenic and maritime sources, depending on the meteorological conditions and wind patterns. Ion balance calculations revealed that organic acids are significant contributors to the overall chemical budget in snow samples. Sixty to ninety-five per cent of the total SO4(2-) was calculated to have been derived from S(IV) oxidation. H2O2 concentrations up to 7.4 micromole/l were analyzed in fresh snow. No systematic trends in the concentrations of H2O2 were observed during collection periods in marked contrast to the behavior of inorganic species (e.g., Na(+), Cl(-), SO4(2-), and NO3(-)). H2O2 concentrations found in snow were 2-3 times lower than those found in rainwater collected during the same events at a lower elevation site, whereas inorganic ion levels were 2-7 times lower in snow. In an accumulated season snowpack a decrease if H2O2 and increase if SO4(2-) with depth was observed. (Author's abstract)
W91-00842

FIELD INVESTIGATIONS ON THE SNOW CHEMISTRY IN CENTRAL AND SOUTHERN CALIFORNIA-II. CARBONYLS AND CARBOXYLIC ACIDS.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
D. W. Gunz, and M. R. Hoffmann.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1673-1684, July 1990. 8 fig, 2 tab, 79 ref. California Air Resources Board Contract A6-185-32.

Descriptors: *Acid rain, *Carbonyls, *Carboxylic acid, *Fate of pollutants, *Organic acids, *Path of pollutants, *Snow, *Snowpack, *Water pollution sources, Acetic acid, Air pollution, Aldehydes, Atmospheric chemistry, Atmospheric water, California, Chemistry of precipitation, Cloud chemistry, Forests, Formaldehyde, Organic compounds, Snow sampling, Snowmelt.

Snow samples from central and southern California were collected during the winter of 1987-1988 from three storms and analyzed for carbonyl compounds and carboxylic acids. Approximately 90% of the samples contained total aldehyde concentrations up to 40 micromole. Formaldehyde and acetaldehyde were the dominant aldehydes observed; secondary aldehydes included glyoxal, methylglyoxal, and benzaldehyde. The highest aldehyde concentrations were observed in snow collected in areas where deciduous and coniferous forests are widespread. However, these aldehydes can be attributed also in part to primary and secondary products of anthropogenic activities. Formic and acetic acid were analyzed in all measured samples with concentrations ranging from 0.5 to 4.9 micromole for HCOOH and from less than 0.3 to 13.4 micro mole for CH3COOH. Maximum contribution of organic acids to precipitation-free acidity, calculated by assuming that the only sources of the measured formate and acetate were their respective acid forms, averaged 43.1% for samples with a pH </= to 5. A consistent correlation between NH4(+) and acetate was found. Concentrations of CH3COOH exceeded those of HCOOH in about 50% of the samples with the highest levels for CH3COOH measured in cores collected from lower elevated locations adjacent to the Los Angeles basin. Results suggest that dry deposition and/or scavenging of carbonyl compounds and organic acids to snow may be important sinks for these compounds. (Author's abstract)
W91-00843

WET AND DRY DEPOSITION FLUXES ABOVE THE NORTH SEA.
Vrije Univ., Brussels (Belgium). Dienst Analytische Scheikunde en Geochemie.
For primary bibliographic entry see Field 2B.
W91-00845

INTENSIVE STUDIES OF SIERRA NEVADA CLOUDWATER CHEMISTRY AND ITS RELATIONSHIP TO PRECURSOR AEROSOL AND GAS CONCENTRATIONS.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 2B.
W91-00846

EFFECT OF DAYTIME SURFACE EVAPORATION ON POLLUTION DISPERSION.
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
M. Segal, X. Jia, Z. Ye, and R. A. Pielke.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1801-1811, July 1990. 8 fig, 1 tab, 32 ref. EPRI Contract RP-1630-53 and NSF Grant ATM-8616662.

Descriptors: *Air pollution, *Air pollution sources, *Dispersion, *Evaporation, *Model studies, Atmospheric chemistry, Convective boundary layer, Mathematical studies, Path of pollutants, Surface evaporation.

The impact of wet surfaces on selected dispersion characteristics was studied in situations involved with extensive homogeneous areas with a uniform surface wetness. Illustrative situations typical to mid-latitude summer and winter days were considered. The simulation results suggest that an extreme variation in surface moisture availability over an extensive area may result in a change of one Pasquill stability class around noon. However, early in the morning and late in the afternoon the modification can be more substantial. A similar, general conclusion was obtained when the ratio w*/U (where w* is the convective scaling velocity and u the mean wind speed w/in the daytime convective boundary layer) was considered as an index for dispersion in the ABL. The impact of a change in the depth of the ABL, from very dry to an extremely wet surface, was indicated to be a factor of approximately 1.5 to 2. Thus, it is suggested, for example, that surface concentrations from a plume trapped within the ABL, or due to surface emissions, may be increased by a factor of 1.5-2 due to such surface moisture variations. On the other hand, a reduction in the ABL depth due to surface moistening may result in the penetration of such a plume to above the ABL capping inversion, thereby reducing significantly the surface concentrations. The last situation is most likely to occur in the morning hours, or in synoptic conditions in which the ABL is suppressed by a synoptic subsidence to the typical effective height of tall stacks. (Korn-PTT)
W91-00848

INFLUENCE OF OUTLIERS ON RESULTS OF WET DEPOSITION MEASUREMENTS AS A FUNCTION OF MEASUREMENT STRATEGY.
Netherlands Energy Research Foundation ECN, Petten.
J. Slanina, J. J. Mols, and J. H. Baard.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1843-1860, July 1990. 4 fig, 10 tab, 18 ref, append.

Descriptors: *Mathematical studies, *Network design, *Path of pollutants, *Sampling, *Statistical analysis, Mathematical equations, Networks, Outlier detection, Precipitation, Sampling strategy, Statistical methods, Statistical models.

The results of a wet deposition monitoring experiment, carried out by eight identical wet-only precipitation samplers operating on the basis of 24 hour samples, have been used to investigate the accuracy and uncertainties in wet deposition measurements. The experiment was conducted near Lelystad, The Netherlands over the period 1 March 1983-31 December 1985. By rearranging the data for one to eight samplers and sampling periods of 1 day to 1 month both systematic and random errors were investigated as a function of measuring strategy. A Gaussian distribution of the results was observed. Outliers, detected by a Dixon test (a=0.05) strongly influenced both the yearly averaged results and the standard deviation of this average as a function of the number of samplers and the length of the sampling period. The systematic bias in bulk elements, using one sampler, varies typically from 2 to 20%, and for trace elements from 10 to 500%. Severe problems are encountered in the case of Zn, Cu, Cr, Ni, and especially Cd. For the sensitive detection of trends generally more than one sampler per measuring station is necessary as the standard deviation in the yearly averaged wet deposition is typically 10-20% relative for one sampler. Using three identical samplers, trends of about 3%/year will be generally detected in 6 years. (Author's abstract)
W91-00849

CHEMICAL CHARACTERIZATION OF ACID PRECIPITATION IN ALBANY, NEW YORK.
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
For primary bibliographic entry see Field 5A.
W91-00850

SOURCE-RECEPTOR RELATIONSHIPS FOR WET SO4(2-) AND NO3(-) PRODUCTION.
G. R. Hilst, and E. G. Chapman.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1889-1901, July 1990. 8 fig, 3 tab, 19 ref, append. EPRI Contract RP1630-40 and RP2434-5.

Descriptors: *Acid rain, *Air pollution, *Chemistry of precipitation, *Data interpretation, *Mathematical studies, *Nitrates, *Path of pollutants, *Statistical analysis, *Sulfates, Nitrogen compounds, North America, Precipitation, Seasonal variation, Sulfur dioxide, Water pollution sources.

Precipitation chemistry data for the years 1982-1985 from 110 stations distributed across the continental U.S. and southern Ontario Province are used to describe the geographic distributions of SO4(2-) and NO3(-) in precipitation. Volume-weighted wet SO4(2-) and NO3(-) concentrations were averaged over the 4 years of observation by season and annually. Results of the observations show that coherent patterns with the maxima in the northeastern U.S. and southeastern Canada are about ten times greater than the minima observed in the Intermountain and Pacific Northwest regions. Tests for empirical source-receptor relationships indicate that in land areas with relatively low emissions of SO2 and NOx, the associations between wet SO4(2-) concentrations and SO2 emissions and wet NO3(-) concentrations and NOx emissions, within 560 km of each precipitation chemistry station, are weak or nonexistent (r2 </ = 0.42). The remaining land areas show moderate to strong associations between SO2 and SO4(2-) and NOx and NO3(-) during the spring and summer, but only weak to nonexistent associations during the winter. The associations between emissions and concentrations are equally well represented by either a linear or power law function. However, at the level of aggregation employed, the data do not substantiate a linear-proportional relationship between concentrations and anthropogenic emissions. Furthermore, emissions of SO2 and NOx are highly correlated, as are the emissions of reactive hydrocarbons and NOx. (Author's abstract)
W91-00851

TRACE METAL WET DEPOSITION IN SWEDEN: INSIGHT GAINED FROM DAILY WET ONLY COLLECTION.
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
H. B. Ross.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1929-1938, July 1990. 7 fig, 6 tab, 21 ref.

Descriptors: *Acid rain, *Air pollution, *Chemistry of precipitation, *Industrial development, *Path of pollutants, *Sweden, *Trace metals, *Water pollution sources, Air pollution sources, Arsenic, Atmospheric chemistry, Cadmium, Chemical analysis, Chromium, Copper, Heavy

metals, Iron, Lead, Manganese, Nickel, Pollutant identification, Statistical analysis, Vanadium, Zinc.

Industrialization has changed the biogeochemical cycling of a variety of trace metals. The so-called atmophile trace metals (e.g., Cd, Cu, Zn, Cr, V, and As) have the atmosphere as their major media for transport in the biosphere. One of the prime characteristics of atmophile metals is that wet deposition is the major mechanism for their removal from the atmosphere. Monthly bulk and daily wet only samples have been collected at two sites in Sweden and analyzed for trace metals (Cd, Cu, Fe, Mn, Pb, Zn, Cr, Ni, and V). Concentrations in the daily samples varied over four orders of magnitude with the most pristine samples (lower 10th percentile) approaching levels found in Greenland snow. It was also observed that monthly metal deposition is essentially governed by the meteorological history of individual precipitation events; namely that monthly metal deposits can be dominated by individual small storms and the remaining precipitation for the month merely dilutes the dirty precipitation. A comparison of deposition estimates from the two data sets indicate that Cd, Fe, Pb, Zn, Cr, Ni, and V wet deposition can be reasonably estimated by monthly bulk sampling. Due to contamination from the forest canopy, Mn wet deposition is overestimated by the bulk method. For Cu, contamination of the samples occurred in both collectors and indicates that new sampling protocols are needed for accurately determining wet deposition fluxes. (Author's abstract)
W91-00853

RELEASE OF HEAVY METALS FROM SNOWPACKS ON THE JAPAN SEA SIDE OF JAPAN.
Kanazawa Univ. (Japan). Dept. of Chemical Engineering.
F. J. Ecker, E. Hirai, and T. Chohji.
Environmental Pollution ENPOEK, Vol. 65, No. 2, p 141-153, 1990. 4 fig, 2 tab, 16 ref.

Descriptors: *Conductivity, *Heavy metals, *Hydrogen ion concentration, *Japan, *Path of pollutants, *Pollutant identification, *Snowmelt, *Snowpack, *Water pollution sources, Air pollution, Aluminum, Cadmium, Chemical composition, Copper, Iron, Lead, Manganese, Snow, Snow sampling, Zinc.

Daily snowfall and meltwater samples were collected at six stations on the Japan Sea (west) side of Japan. Samples were analyzed for ionic strength (EC), pH, and soluble and insoluble amounts of Fe, Mn, Pb, Cd, Cr, Cu, Zn, and Al. Consistent patterns of chemical composition were found in freshly fallen snow at all locations. However, meltwater from inland mountain snowpacks varied from coastal meltwater. At the coastal sites, lysimeter samples showed a release of meltwater from the snowpack to the ground all winter. At a remote mountain site the meltwater breakthrough was delayed and was restricted to a relatively short period. Most of the impurities at mountain sites were retained in the snowpack until spring. The first fraction of meltwater released between 50 and 90% of the total amount of soluble metal components. The last meltwater contained the maximum of insoluble metals. The high ionic strength and the enrichment of bioavailable heavy metals in the first meltwater breakthrough was caused by preferential elution; this impurity laden first release undoubtedly reaches aquatic systems and may affect aquatic biota. (Author's abstract) (Korn-PTT)
W91-00858

RELATIONSHIPS BETWEEN COPPER CONCENTRATIONS IN LARVAE OF PLECTROCNEMIA CONSPERSA (CURTIS) (TRICHOPTERA) AND IN MINE DRAINAGE STREAMS.
Polytechnic South West, Plymouth (England). Dept. of Biological Sciences.
A. M. Gower, and S. T. Darlington.
Environmental Pollution ENPOEK, Vol. 65, No. 2, p 155-168, 1990. 5 fig, 4 tab, 25 ref.

Descriptors: *Caddisflies, *Copper, *Larvae, *Mine wastes, *Path of pollutants, *Population exposure, *Stream pollution, *Sublethal effects, *Water pollution effects, Bioaccumulation, England, Heavy metals, Larval growth stage, Stream biota, Tolerance.

Mine drainage streams in the heavily mineralized moorland areas of Cornwall, south-west England, are characterized by continuous flow and hence continuous metal contamination. Since many of these streams have been in existence for up to 250 years, the aquatic communities consist of tolerant species. Although studies in the UK and the USA show that insects, especially Chironomidae, Trichoptera, and Ephemeroptera, are often the dominant macroinvertebrates in streams contaminated by heavy metals, comparatively little is understood about the tolerance mechanisms and concentrations of metals in insects under different environmental conditions. Elevated copper concentrations were determined for single larvae of Plectrocnemia conspersa in a copper-rich stream. Although larval copper concentrations were reduced by at least 50% after clearing gut contents, the exponential decrease with increasing body weight remained unchanged. Analysis of instar V larvae from different sampling stations showed a steep increase in the concentration of copper in the larvae, with that in the water at lower stream water concentrations followed by a progressively less steep increase at higher stream concentrations. When captive larvae from a clean stream were introduced into a mine drainage stream, the amount of copper in fed and unfed larvae steadily increased, suggesting metal uptake from water and food. Survival and growth were comparable for introduced and captive resident larvae suggesting copper tolerance to be a general characteristic of P. conspersa. (Korn-PTT)
W91-00859

SEASONAL, HYDROLOGICAL, AND LAND MANAGEMENT FACTORS CONTROLLING DISSOLVED ORGANIC CARBON CONCENTRATIONS IN THE LOCH FLEET CATCHMENTS, SOUTHWEST SCOTLAND.
Stirling Univ. (Scotland). Dept. of Environmental Science.
For primary bibliographic entry see Field 2H.
W91-00862

F-SPECIFIC RNA BACTERIOPHAGES AND SENSITIVE HOST STRAINS IN FAECES AND WASTEWATER OF HUMAN AND ANIMAL ORIGIN.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
For primary bibliographic entry see Field 5A.
W91-00872

EFFECTS OF FAULTS ON FLUID FLOW AND CHLORIDE CONTAMINATION IN A CARBONATE AQUIFER SYSTEM.
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00877

MOVEMENT AND FATE OF ATRAZINE AND BROMIDE IN CENTRAL KANSAS CROPLANDS.
Kansas State Geological Survey, Lawrence.
M. Sophocleous, M. A. Townsend, and D. O. Whitemore.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 115-137, July 1990. 21 fig, 20 ref.

Descriptors: *Agricultural chemicals, *Atrazine, *Bromides, *Fate of pollutants, *Path of pollutants, *Pesticides, *Soil analysis, *Soil contamination, Biodegradation, Flow measurement, Lysimeters, Soil porosity, Soil water, Solute transport, Tracer studies.

Recent incidences of chemical contamination of groundwater by pesticides and other agricultural chemicals have increased concern for long-term environmental consequences of current agricultural practices on groundwater quality. Two flooding experiments were conducted at two sites with different soils to study the transport and fate of the commonly used herbicide atrazine and inorganic chemicals in the Great Bend Prairie croplands of south-central Kansas. The instantaneous profile method supplemented by the use of an organic (atrazine) and an inorganic (bromide) tracer chemical was used to characterize in situ the hydraulic and chemical properties of the appropriately instrumented field sites. Atrazine readily degraded to hydroxyatrazine and biodegradation by-products and was not detected deeper in the soil profile and underlying shallow aquifer. The classical processes of chemical movement based on porous media-equilibrium-diffuse flow did not fit the data well at either site. Incompletely mixed, slug flow appeared to predominate at one of the sites and preferential flow at the other. The slug movement caused 'piston-type' displacement of more saline solutions in the soil profile to the shallow water table. Recommendations for conducting related field studies based on this sampling experience are: (1) collect multiple samples per depth over a small area of interest (representing, in effect, a point measurement) and use the average concentration per depth for analysis; (2) sample the entire depth of interest in one continuous core; (3) do not rely entirely on suction lysimeters, both soil cores and suction lysimeters are recommended; and (4) chemical analyses should be conducted as soon as possible after sampling, so that problems can be addressed and resampling carried out if necessary. (Author's abstract)
W91-00882

THEORY AND APPLICATION OF AN APPROXIMATE MODEL OF SALTWATER UPCONING IN AQUIFERS.
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 2F.
W91-00883

MOTION OF COASTAL GROUNDWATER IN RESPONSE TO THE TIDE.
Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
For primary bibliographic entry see Field 2F.
W91-00884

TOPOGRAPHIC EFFECTS ON FLOW PATH AND SURFACE WATER CHEMISTRY OF THE LLYN BRIANNE CATCHMENTS IN WALES.
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 2E.
W91-00888

SIMULATION OF NITRATE NITROGEN BREAKTHROUGH CURVES STEMMING FROM LEACHING OF AMMONIUM NITRATE THROUGH SOIL.
Orissa Univ. of Agriculture and Technology, Bhubaneswar (India).
B. K. Mishra, and C. Misra.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 377-384, July 1990. 4 fig, 13 ref.

Descriptors: *Ammonium salts, *Leaching, *Nitrates, *Nonpoint pollution sources, *Path of pollutants, *Soil chemistry, *Soil water, *Water pollution sources, Chemical analysis, Data analysis, Diffusion coefficient, Graphical analysis, Ion transport, Nitrification, Solute transport.

Simulations of breakthrough curves (BTCs) of NO3-N stemming from leaching a solution pulse of NH4NO3 requires the knowledge of several parameters, such as the distribution coefficient, R, for NH4(+)-N, convective diffusion coefficient, D, the nitrification rate constant, k1, and the nitrate reduction rate constant, k2, to be determined independently. Unlike D, the values of R do not affect the appearance of the BTCs of NO3-N or the velocity of the solute species. R can be estimated directly from the slope of the linear adsorption isotherms of a batch equilibrium study. Since the value of D is related to the velocity of ions, D can be estimated by curve fitting a BTC of Cl-, under identical conditions. Increasing k2 decreases the area under the NO3-N BTC. The value of k2 may be estimated by curve fitting the BTC of NO3-N stemming from leaching of a solution pulse of

Ca(NO3)2. With estimates of R, D, and k2 in hand, one has only to curve-fit the BTC of NO3-N stemming from leaching a solution pulse of NH4NO3 in order to estimate k1. For a given k2, increasing the value of k1 increases the area under BTCs of NO3-N for the earlier times. (Author's abstract)
W91-00896

UNDERGROUND STORAGE TANKS.
Clean Site, Inc., Alexandria, VA.
For primary bibliographic entry see Field 5G.
W91-00904

5C. Effects Of Pollution

SIMULATION MODEL OF PHOSPHORUS CYCLING IN THE EPILIMNION OF A EUTROPHIC LAKE.
Polish Academy of Sciences, Warsaw. Zaklad Paleobiologii.
For primary bibliographic entry see Field 2H.
W91-00003

RESEARCH ON THE FISHERIES OF SMALL LAKES (PIENTEN JARVIEN KALATUTKIMUKSET).
For primary bibliographic entry see Field 8I.
W91-00019

GENOTOXICITY OF DRINKING WATER: SIGNIFICANCE AND FUTURE APPROACH.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
J. F. Versteegh, P. G. Kramers, and J. van Genderen.
Aqua AQUAAA, Vol. 39, No. 2, p 101-106, April 1990. 1 ref.

Descriptors: *Drinking water, *Genotoxicity, *Mutagenicity, *Water pollution effects, *Workshops, Chlorination, Epidemiology, Public health, The Netherlands, Water treatment.

A workshop was organized by the National Institute for Public Health and Environmental Protection of the Netherlands and the Netherlands Waterworks Testing and Research Institute on the subject of genotoxicity of drinking water. Significant conclusions of this workshop included: (1) An important part of the mutagenicity of drinking water cannot be explained despite the identification of several potent mutagenic compounds. (2) In-vivo studies with drinking-water extracts do not yet confirm the mutagenic activity discovered in vitro. (3) Some epidemiological studies in the USA have shown that the prolonged consumption of chlorinated drinking water is associated with increased health risks. (4) It is to be recommended that, even though the implications of mutagenicity are not fully known, measures should be taken to decrease their concentration in drinking water. (Stoehr-PTT)
W91-00023

EFFECTS OF DRILL CUTTINGS ON A MODEL MARINE SEDIMENT SYSTEM.
Heinz and Co. Ltd., Hayes (England). Microbiology Dept.
F. K. Dow, J. M. Davies, and D. Raffaelli.
Marine Environmental Research MERSDW, Vol. 29, No. 2, p 103-134, 1990. 15 fig, 5 tab, 47 ref.

Descriptors: *Biodegradation, *Drill cuttings, *Drilling fluids, *Marine sediments, *Model studies, *Path of pollutants, *Water pollution effects, Anaerobic conditions, Environmental impact, Hydrocarbons, North Sea, Oil pollution, Sediment contamination.

An onshore tank system was used to model marine sediment contaminated with water, diesel oil, and paraffinic oil-based cuttings from offshore drilling installations. The relative environmental impact of the different cuttings was assessed over a 12-month period in terms of changes in sediment microbiology and chemistry. Changes in hydrocarbon chemistry were also determined to provide information on oil composition and mechanisms of oil loss from the cuttings. Water-based cuttings proved least damaging to the sediment system, only depressing Eh levels below those of control sediments during the first three months of exposure. Both types of oil-based cuttings stimulated microbial activity, depressing sediment Eh levels and increasing sulfide concentrations. The effects were less severe in more lightly contaminated sediments. Oil losses were proportionally greater from more dispersed cuttings and were dependent on both physical and biological weathering. Sediments heavily dosed with oil-based cuttings became anaerobic and failed to support hydrocarbon biodegradation. More dispersed low dosage applications were more readily susceptible to microbial attack. (Author's abstract)
W91-00044

MACROPHYTE ASSOCIATED INVERTEBRATES AND THE EFFECT OF HABITAT PERMANENCE.
Lund Univ. (Sweden). Dept. of Ecology.
For primary bibliographic entry see Field 2H.
W91-00052

MEASURING ECONOMIC LOSSES FROM GROUND WATER CONTAMINATION: AN INVESTIGATION OF HOUSEHOLD AVOIDANCE COSTS.
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
C. W. Abdalla.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 451-463, June 1990. 1 fig, 9 tab, 22 ref.

Descriptors: *Domestic water, *Economic aspects, *Groundwater pollution, *Water pollution effects, Bottled water, Pennsylvania, Volatile organic compounds, Water treatment, Well water.

Economic losses from groundwater contamination were estimated in a central Pennsylvania community. The averting expenditures method was applied by using a mail survey of households in which water contained the unregulated volatile organic chemical, perchloroethylene (PCE). Expenditures evaluated were for purchasing bottled water, hauling water, boiling water, and water treatment. Expenditures were estimated at $148,900 (1987 dollars) over the six-month contamination period or approximately $252 per household annually. These costs underestimate the lower bound measure of welfare losses to households from groundwater contamination. An upper bound measure of welfare losses was estimated at $383 per household annually. These estimates do not represent the full economic losses resulting from groundwater contamination since the study did not address municipal-level and business avoidance costs and losses from actual health effects, increased fear and anxiety, ecological damages, and nonuser groundwater benefits. The results expand the existing empirical base of information about municipal-level responses and economic losses from groundwater contamination to include household-level impacts. The findings indicate that households undertake substantial averting actions in response to groundwater contamination and that such actions can have significant economic consequences. The extent and magnitude of avoidance costs documented suggests that policy-makers should give greater attention to this category of economic losses. (Author's abstract)
W91-00086

LONGITUDINAL AND SEASONAL WATER CHEMISTRY VARIATIONS IN A NORTHERN APPALACHIAN STREAM.
Marian Coll., Indianapolis, IN. Dept. of Biology.
For primary bibliographic entry see Field 2K.
W91-00089

POSTTREATMENT EFFECTS OF FOREST FERTILIZATION ON THE PREDOMINANT BENTHIC COMMUNITY OF A HEADWATER STREAM IN EASTERN KENTUCKY.
Southern Illinois Univ., Carbondale. Dept. of Zoology.
M. A. Phillippi, and G. B. Coltharp.
Transactions of the Kentucky Academy of Science TKASAT, Vol. 51, No. 12, p 18-25, March 1990. 6 fig, 1 tab, 32 ref.

Descriptors: *Fertilizers, *Forest fertilization, *Forestry, *Invertebrates, *Kentucky, *Nitrates, *Water pollution effects, Benthic fauna, Biomass, Ephemeroptera, Flies, Plecoptera, Species composition, Species diversity, Streams, Water pollution.

A posttreatment analysis was conducted on the benthic invertebrate community of a small headwater stream in eastern Kentucky that had been affected by a forest fertilization project in 1975. During the biological sampling period (1978-1981), significantly higher concentrations of nitrate-nitrogen were present in the affected stream when compared with two unaffected streams. Standing-crop biomass of invertebrates (wet weight), volumetric displacement, and the number of individuals were not significantly different between the treated stream and one untreated stream, suggesting that the fauna was not using the nitrate-nitrogen subsidy to increase biomass. However, the number of taxa and species diversity (Sequential Comparison Index) were significantly higher in the stream located within the unfertilized watershed. The most abundant invertebrates in both streams were the Diptera, Ephemeroptera, and Pleocoptera. Most species were dipterans. The observed differences between the streams could indicate that the affected stream is in the process of recovery. This possibility seems unlikely considering the length of time since fertilization, the abundant sources of recolonizers, and the absence of any disturbance since fertilization. The benthic fauna is therefore, considered presently unaffected by the previous forest fertilization. (Author's abstract)
W91-00109

INFERENCES ABOUT POINT SOURCE LOADING FROM UPSTREAM/DOWNSTREAM RIVER MONITORING DATA.
International Joint Commission-United States and Canada, Windsor (Ontario).
For primary bibliographic entry see Field 5B.
W91-00135

ASPECTS OF CARBON METABOLISM IN THE RECOVERY OF SELENASTRUM CAPRICORNUTUM POPULATIONS EXPOSED TO CADMIUM.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
P. A. Thompson, and P. Couture.
Aquatic Toxicology AQTODG, Vol. 17, No. 1, p 1-14, July 1990. 6 fig, 2 tab, 45 ref. NSERC Canada Grant No. A8123.

Descriptors: *Algae, *Carbon, *Heavy metals, *Toxicity, *Water pollution effects, Adenosine triphosphate, Biological oxidation, Cadmium, Chlorophyta, Lipids, Metabolism, Proteins, Respiration, Trace metals.

The role of macromolecules (proteins, lipids, polysaccharides, low molecular weight metabolites), adenylate nucleotides (ATP, ADP) and respiration was studied in Selenastrum capricornutum populations exposed to Cd to test the hypotheses that C metabolism is stimulated during exposure and recovery, and that growth recovery to Cd is promoted by the activation of an ATP-producing pathway. Populations acclimated to Cd despite growth inhibition. Higher protein and storage product cellular quotas appeared to maintain viability and allow recovery after Cd was complexed by EDTA. Growth recovery was related to a stimulation of respiration (oxidative phosphorylation) above control levels and is accompanied by higher ATP/cell and ATP/ADP ratios. In the more severely stressed population (100 micrograms Cd/L), recovery required the metabolism of lipids; cellular lipid levels first increase, and then at the onset of growth recovery lipids were used as a respiratory substrate. (Author's abstract)
W91-00191

REPRODUCTIVE STRATEGY OF DAPHNIA MAGNA AFFECTS THE SENSITIVITY OF ITS PROGENY IN ACUTE TOXICITY TESTS.
Ministry of Transport and Public Works, Lelystad (Netherlands). Lab. for Ecotoxicology.
For primary bibliographic entry see Field 5A.
W91-00192

INFLUENCE OF PH, TEMPERATURE AND SEDIMENT TYPE ON THE TOXICITY, ACCUMULATION AND DEGRADATION OF PARATHION IN AQUATIC SYSTEMS.
Ohio State Univ., Columbus. Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W91-00193

AGE-DEPENDENT CHANGES IN TOXICITY OF N-NITROSO COMPOUNDS TO JAPANESE MEDAKA (ORYZIAS LATIPES) EMBRYOS.
California Univ., Davis. School of Veterinary Medicine.
G. D. Marty, J. M. Nunez, D. J. Lauren, and D. E. Hinton.
Aquatic Toxicology AQTODG, Vol. 17, No. 1, p 45-62, July 1990. 6 fig, 4 tab, 41 ref. USPHS Grant No. ES-04699 and NIEHS Grant No. 5 T32 ES07055.

Descriptors: *Embryonic growth stage, *Fish physiology, *Mutagens, *Nitroso compounds, *Teratogenic effects, *Toxicity, *Water pollution effects, Animal metabolism, Chronic toxicity, Laboratory methods, Toxicology.

Three different developmental stages of embryonated eggs of Oryzias latipes were exposed to 2-h pulses of a number of different concentrations of N-nitroso-N-methylurea (MNU), N-methyl-N'-nitro-N-nitrosoguanidine (MNNG), and N-nitrosodiethylamine (DENA). Lethality and teratogenic end-points were assessed through 24 h posthatch. MNU (>= 2.5 mM) and MNNG (>= 0.75 mM) exposure at the multicell stage was lethal, but the same exposure during early organogenesis was largely teratogenic. Four days before hatching, embryos were very resistant to MNU and proceeded to hatch normally; 7.5 mM MNU was required to significantly reduce the percent normal hatch. Effects of DENA were equivocal and only seen at the multicell stage. In order to differentiate between potential changes in chorion permeability, and toxicity per cell, the same three stages were exposed to a series of radiolabeled compounds of varying hydrophobicity, and apparent uptake measured. There were no differences in uptake rate or equilibrium concentration between any of the compounds at the different stages. These results suggest that, as in mammals, certain stages of development are more susceptible than others, and that these differences are a result of embryo sensitivity rather than chemical bioavailability. the most sensitive indicator of exposure was posthatch inflation of the swimbladder. Other terata included pericardial edema, anisophthalmia, and partial rupture of the chorion. (Author's abstract)
W91-00194

COMPARATIVE QSAR STUDY ON FRESHWATER AND ESTUARINE TOXICITY.
Fraunhofer-Inst. fuer Umweltchemie und Oekotoxikologie, Schmallenberg (Germany, F.R.).
M. Nendza, and W. Klein.
Aquatic Toxicology AQTODG, Vol. 17, No. 1, p 63-73, July 1990. 4 fig, 4 ref, 14 ref.

Descriptors: *Aromatic compounds, *Structure-activity relationships, *Toxicity, *Toxicology, *Water pollution effects, Algae, Bacteria, Benzenes, Crustacea, Estuaries, Fish, Freshwater, Multivariate analysis, Phenols, Regression analysis, Statistical methods.

Biological testing is an expensive and time consuming-tool to assess the hazard of potential toxicants. Classification (i.e. ranking in toxicity) can be achieved using computational techniques and thus compounds to be examined in detail can be identified. Toxicity data obtained with one species are related to the structure of the chemicals, formalized by Quantitative Structure-Activity Relationships (QSARs). Regression analysis was applied to examine the structure-toxicity relationships regarding the acute toxicity of 10 phenol and benzene derivatines to various freshwater and estuarine organisms (fish, algae, crustacea, bacteria) for a series of substituted aromatic compounds. Linear relationships between the toxicity and the log P(oo) partition coefficient have been obtained for non-reactive chemicals. Increased partitioning into lipophilic phases of the biosystem enhances the toxic effect. The structure-toxicity relationships are evaluated with regard to species differences. Multivariate procedures reveal collinearities in the response of several aquatic organisms to aromatic compounds. Analysis of interspecies correlations demonstrates coinciding toxicity ranking with different aquatic test systems for chemicals acting by a uniform mode of action. (Author's abstract)
W91-00195

SEASONAL VARIABILITY IN THE SENSITIVITY OF FRESHWATER LENTIC COMMUNITIES TO A CHRONIC COPPER STRESS.
Miami Univ., Oxford, OH. Dept. of Zoology.
R. W. Winner, A. Owen, and M. V. Moore.
Aquatic Toxicology AQTODG, Vol. 17, No. 1, p 75-92, July 1990. 9 fig, 1 tab, 32 ref.

Descriptors: *Benthic environment, *Bioindicators, *Copper, *Lentic environment, *Seasonal variation, *Water pollution effects, Benthic fauna, Cladocera, Dissolved organic carbon, Ecosystems, Freshwater, Heavy metals, Phytoplankton, Ponds, Trace metals, Zooplankton.

In situ enclosures were used to evaluate differences in the seasonal response of planktonic and benthic communities to chronic Cu exposures in a small, oligotrophic pond. Communities were exposed to 0, 20 or 40 micrograms Cu/L for 5-wk durations during April, June-July and October-November. Both phytoplankton and zooplankton were much more sensitive to Cu in the spring than in the summer or fall. It is postulated that this is because of seasonal changes in the Cu-binding capacity of the pond water due to seasonal changes in dissolved organic carbon concentrations. Cladocerans, which are widely used as invertebrate 'white rats' to evaluate the toxicity of chemicals and predict their effect on freshwater ecosystems, were the least sensitive to Cu of all the zooplankton. This indicates that more caution should be exercised in projecting results of laboratory tests with supposedly sensitive species to complex, natural communities. (Author's abstract)
W91-00196

MODELING THE EFFECT OF ALGAL BIOMASS ON MULTISPECIES AQUATIC MICROCOSMS RESPONSE TO COPPER TOXICITY.
Washington Univ., Seattle. Applied Physics Lab.
G. L. Swartzman, F. B. Taub, J. Meador, C. Huang, and A. Kindig.
Aquatic Toxicology AQTODG, Vol. 17, No. 2, p 93-117, August 1990. 4 fig, 3 ref, 35 ref.

Descriptors: *Algae, *Copper, *Ecosystems, *Mathematical models, *Model studies, *Toxicity, *Water pollution effects, Biomass, Heavy metals, Mathematical equations, Microcosms, Phytoplankton, Statistical analysis, Trace metals, Water chemistry, Zooplankton.

A model was developed to simulate the effects of copper on an aquatic microcosm consisting of 10 phytoplankton species and 5 zooplankton species grown in a defined medium. The Cu toxicity equations in the model were based on the results of single species toxicity tests at different initial cell densities. Model output was evaluated by comparing predictions with results of replicated 35 day microcosm experiments having copper added at 3 different times (days 7, 14 or 21) at 500 ppb concentration. These experiments offered a wide range of plankton and nutrient conditions at the time of Cu addition. The baseline for these experiments was set by a control experiment, with no Cu addition and a model, MICMOD, developed to simulate microcosm behavior. Two toxicity models were tested; the 'neutral' model defined Cu toxicity to plankton as depending only on the dissolved Cu concentration in the medium, while the 'biomass' model also decreased toxicity in proportion to algal biomass. Graphical and statistical comparisons showed the toxicity model including algal biomass to better fit the data. Both the experimental results and the model suggest that the effects of Cu may be strongly influenced by the density and species composition of the biota and the related differences in water chemistry at the time of Cu addition. The apparent importance of algal biomass to Cu toxicity may be due to: (1) changing Cu availability either through direct absorption or adsorption; (2) production of chelates by the algae which complex Cu in less toxic forms; or, (3) changing the pH which affects Cu ionization and particularly the concentration of the cupric ion, Cu(+2), form, which is highly toxic. (Author's abstract)
W91-00197

INDUCED CYTOCHROME P-450 IN INTESTINE AND LIVER OF SPOT (LEIOSTOMUS XANTHURUS) FROM A POLYCYCLIC AROMATIC HYDROCARBON CONTAMINATED ENVIRONMENT.
Virginia Inst. of Marine Science, Gloucester Point.
P. A. Van Veld, D. J. Westbrook, B. R. Woodin, R. C. Hale, and C. L. Smith.
Aquatic Toxicology AQTODG, Vol. 17, No. 2, p 119-131, August 1990. 4 fig, 2 tab, 33 ref. NIH Grant No. CA44306 and ES4220, EPA Cooperative Agreement CR813155.

Descriptors: *Chesapeake Bay, *Cytochromes, *Fish, *Polycyclic aromatic hydrocarbons, *Water pollution effects, Animal metabolism, Bioindicators, Elizabeth River, Fish physiology, Immunoassay, Laboratory methods, Liver, River sediments, Sediment analysis, Sediment contamination.

Levels of total cytochrome P-450, of specific P-450 (determined immunologically with monoclonal antibody MAb 1-12-3 and referred to as P-450E) and ethoxyresorufin O-deethylase (EROD) were elevated in intestine and liver microsomes of spot (Leiostomus xanthurus) collected from the Elizabeth River, a polycyclic aromatic hydrocarbon (PAH) contaminated tributary of Chesapeake Bay. Fish were collected over a sediment PAH concentration gradient that ranged from 9 to 96000 micrograms PAH/kg dry sediment. Intestinal P-450E was near the lower limits of detection in fish collected at the relatively clean sites but was elevated 80-fold to 100-fold in fish collected from contaminated sites. Intestinal EROD activity exhibited a similar trend. Liver P-450E and associated EROD activity was detectable in all samples and was induced approximately eight-fold at the most heavily contaminated site. Despite the sensitivity of the intestine to PAH inducing agents, intestinal P-450E levels did not correlate well with sediment PAH, whereas liver P-450E did. Instead, the intestinal enzyme was induced to similar and high levels at all contaminated sites. The results suggest that the intestine plays an important role in the absorption and metabolism of dietary PAH and/or other PAH-type inducing agents and that intestinal P-450E may be a useful indicator of exposure to these compounds via the diet. (Author's abstract)
W91-00198

FUNCTIONAL AND PATHOLOGICAL IMPAIRMENT OF JAPANESE MEDAKA (ORYZIAS LATIPES) BY LONG-TERM ASBESTOS EXPOSURE.
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
S. E. Belanger, D. S. Cherry, and J. Cairns.
Aquatic Toxicology AQTODG, Vol. 17, No. 2, p 133-154, August 1990. 6 fig, 9 tab, 39 ref. DOI BuMines Grant No. G1174151.

Descriptors: *Asbestos, *Embryonic growth stage, *Fish, *Fish physiology, *Toxicity, *Water pollution effects, Animal metabolism, Animal pathology, Carcinogens, Chronic toxicity, Electron microscopy, Hatching, Histology, Laboratory methods, Toxicology.

Chrysotile asbestos is a fibrous contaminant of water supplies in the United States, Canada and abroad. Evaluations of the effects of chrysotile were made on all life stages of the cyprinodontid fish, the Japanese Medaka (Oryzias latipes). These included: egg hatchability and survival; larval to juvenile growth, survival, histopathology and asbestos bioaccumulation; and adult reproduction and asbestos bioaccumulation. Asbestos did not substantially impair the egg stage at concentrations of less than 100 million fibers/L. Larval and juvenile fish were the most sensitive stages with significant growth reductions occurring at 1-100 million fibers/L and 100% mortality at 10 billion fibers/L in 56 days of exposure. At 10 billion fibers/L, direct evidence (transmission electron microscopy of selected tissues) of chrysotile accumulation was present with concomitant epidermal lesions. A small percentage (5% of those originally exposed) of fish at 10 billion fibers/L developed ventral non-invasive epidermal hyperplastic plaques. Reproduction tests resulted in 33% greater spawning frequency in control populations (compared to 10,000 to 100 million fibers/L) and 25% more viable eggs. It is concluded that chrysotile may represent a significant environmental hazard, especially to young fish, and that asbestos should receive greater attention than it has historically received. (Author's abstract)
W91-00199

AMBIENT AMMONIA, DIET AND GROWTH IN LAKE TROUT.
Guelph Univ. (Ontario). Dept. of Zoology.
F. W. H. Beamish, and A. Tandler.
Aquatic Toxicology AQTODG, Vol. 17, No. 2, p 155-166, August 1990. 1 fig, 3 tab, 48 ref. NSERC Canada Grant No. A3218.

Descriptors: *Ammonia, *Fish growth, *Fish physiology, *Trout, *Water pollution effects, Feeding rates, Fish diets, Toxicity, Toxicology.

Juvenile lake trout were exposed to ambient free (un-ionized) ammonia concentrations of 0, 99, 198 and 297 micrograms NH3-N/L for 60 days and fed one of two diets which were similar in energy concentration. Diet did not influence food intake at ammonia concentrations of 0, 99 and 198 micrograms ammonia nitrogen (NH3-N)/L. Food intake was unaffected by ammonia concentrations of 0 and 99 micrograms NH3-N/L and was only temporarily reduced when ammonia was 198 micrograms NH3-N/L. Trout exposed to 297 micrograms NH3-N/L consumed significantly less food than fish exposed to the lower concentrations of ammonia. Food intake did not differ with diet during the first 30 days of exposure to 297 micrograms NH3-N/L but during the final 30 days, it was higher for trout fed the low protein diet. Growth, measured as a change in live body weight was not influenced by ammonia concentrations of 0, 99 and 198 micrograms NH3-N/L but declined significantly at 297 micrograms NH3-N/L. Weight gain tended to be larger for trout fed the high protein diet. Efficiency of protein-N gain was greater for trout fed the low protein diet, presumably as a consequence of a sparing effect afforded by high dietary lipid. Efficiency of protein-N gain was significantly reduced among lake trout exposed to the highest concentration of ammonia. Mortalities were observed only among trout exposed to the highest concentration of ammonia. (Author's abstract)
W91-00200

ARSENIC-INDUCED ULTRASTRUCTURAL CHANGES IN THE VEGETATIVE CELLS OF CYSTOSEIRA BARBATA FORMA REPENS ZINOVA ET KALUGINA (FUCOPHYCEAE, FUCALES).
Centre Univ. de Luminy, Marseille (France). Lab. de Biologie Marine Fondamentale et Appliquee.
L. Pellegrini, S. G. Delivopoulos, and M. Pellegrini.
Botanica Marina BOTNA7, Vol. 33, No. 3, p 229-234, May 1990. 6 fig, 33 ref. NATO Grant No. 87/0028.

Descriptors: *Arsenic, *Cytology, *Marine algae, *Toxicity, *Water pollution effects, Microscopic analysis, Seawater.

One of the most toxic marine pollutants appears to be arsenic and its accumulation in marine organisms, especially edible algae, has become a serious problem in some countries such as Japan. An attempt was made to observe whether ultrastructurally discernible effects involving any of the cell organelles could be visibly related with the arsenic toxicity on a brown alga a free-living form of Cystoseira barbata which is known for its uptake of metals. The effects of arsenic on the fine structure of this brown alga were examined by incubating the axes of thallus in 20 micrograms As/L of seawater for 6 and 16 days. Important changes were observed in different cell organelles. Mitochondria and golgi cisternae appeared to swell . The chloroplast and thylakoid membranes often became undiscernible. The outer cell walls showed some alterations with a loose arrangement of fibrils. (Hoskin-PTT)
W91-00202

GILL LESIONS IN THE PERCH, ANABAS TESTUDINEUS, SUBJECTED TO SEWAGE TOXICITY.
Gorakhpur Univ. (India). Dept. of Zoology.
A. S. Narain, A. K. Srivastava, and B. B. Singh.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 235-242, August 1990. 6 fig, 16 ref.

Descriptors: *Fish pathology, *Gills, *Histology, *Perch, *Sewage, *Water pollution effects, Animal pathology, India, Microscopic analysis, Municipal wastes, Municipal wastewater, Respiration.

Sewage is a major pollutant of the freshwater bodies of the Gorakhpur region of India. Sewage effluent has been found to cause considerable damage to the freshwater fish and shellfish of this region. This study describes the histopathological changes produced in the gills of the perch, Anabas testudineus, maintained in sewage. Gills were examined microscopically every 24 hr from fish exposed to sewage diluted to 25%. Hyperplasia of branchial epithelium was found to be the most pronounced damage caused by the sewage. This effect appeared by the second day of exposure and advanced progressively. The proliferated gill epithelium exposed to sewage for 6-10 d was also seen to separate from the pilaster stalk and the gill ray in many gill filaments. In a number of secondary gill lamellae of Anabas testudineus damaged by exposure to sewage for 7-10 d the pillar cell system also appeared to collapse. All of these changes would be likely to limit the respiratory capacity of the gills and cause respiratory distress, especially under the high temperature conditions that prevail in the Gorakhpur region. These results strengthen the recommendations that sewage deserves more attention than it presently gets in comparison to other pollutants such as heavy metals and pesticides. (Hoskin-PTT)
W91-00205

IN VITRO INHIBITION OF ACETYLCHOLINESTERASE FROM FOUR MARINE SPECIES BY ORGANOPHOSPHATES AND CARBAMATES.
Institut Francais de Recherche pour l'Exploitation de la Mer, Nantes. Lab. of Biochemistry.
For primary bibliographic entry see Field 5A.
W91-00206

BEHAVIORAL CHANGES IN GAMMARUS PULEX AND ITS SIGNIFICANCE IN THE TOXICITY ASSESSMENT OF VERY LOW LEVELS OF ENVIRONMENTAL POLLUTANTS.
Reading Univ. (England). Dept. of Physiology and Biochemistry.
J. T. Borlakoglu, and R. Kickuth.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 258-265, August 1990. 4 fig, 2 tab, 7 ref.

Descriptors: *Acute toxicity, *Animal behavior, *Bioindicators, *Chlorinated hydrocarbons, *Chlorination, *Gammarus, *Phenols, *Water pollution effects, Drinking water, Laboratory methods, Pollutant identification, Toxicity, Toxicology, Water treatment.

Chlorination of drinking water invariably results in the production of a complex, very low-concentration, mixture of chrorophenolic compounds due to the interaction of chlorine with phenolic contaminants. A study was conducted to assess the effects of these chemicals at very low levels. The fresh water amphipod Gammarus pulex, a sensitive indicator organism for environmental pollution, was exposed under controlled conditions to sub-lethal levels of a previously identified major plant-derived chorophenolic derivative. Swimming behavioral changes, escape reactions and measurements of activity of G. pulex were carried out at levels of 5% of the acute oral toxicity level. Sublethal intoxicant effects, defined as changes in expected behavior and biological response, were seen in G. pulex at these exposure levels. The observed changes in swimming behavior and activity of G. pulex are important alterations which could lead to an impaired survival ability in the natural ecosystem. These results suggest that behavioral studies provide important and vital information in understanding the ecotoxicology of environmental pollutants and their ecological significance. (Hoskin-PTT)
W91-00207

EFFECTS OF DELTAMETHRIN AND ETHANOL ON SURVIVAL, AND MECHANICAL RESPONSE OF DAPHNIA SPINULATA.
Universidad Nacional de Lujan (Argentina). Lab. of Ecotoxicology.
J. L. Alberdi, N. O. Santamaria, and D. A. Hernandez.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 266-271, August 1990. 2 fig, 2 tab, 9 ref.

Descriptors: *Acute toxicity, *Biocides, *Daphnia, *Pesticides, *Water pollution effects, Animal behavior, Bioassay, Toxicology.

Deltamethrin (DM) is a powerful biocide, extensively used in domestic pest control and in some agricultural practices. Species of the genus Daphnia are the most frequently used zooplankton organisms in toxicological bioassays. The effects of DM and its solvent on mortality and mechanical response of individuals of D. spinulata were evaluated. These experiments indicated a high sensitivity of D. spinulata to the toxic effect of this pesticide. At 24 hr of exposure, 50% of the individuals died in the concentration range 2.5-10.0 micrograms/L. At 48 hr the mortality increased up to 1.25 micrograms/L. At 72 hr, 45% of the individuals were dead in the lowest assayed concentration (0.31 micrograms/L). In the mechanical stimulus tests, no significant changes were observed at 48 hr exposure with concentrations of 0.31-0.62 micrograms/L. The survivors at 1.25 micrograms DM/L showed intoxication, indicated by a motor inability to get an effective response to mechanical stimulus. (Hoskin-PTT)
W91-00208

COMPARATIVE TOXICITY OF AN EFFLUENT FROM A CHLOR-ALKALI INDUSTRY AND HGCL2.
Berhampur Univ. (India). Dept. of Botany.
B. P. Shaw, and A. K. Panigrahi.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 280-287, August 1990. 1 fig, 2 tab, 16 ref.

Descriptors: *Acute toxicity, *Industrial wastes, *Mercury, *Water pollution effects, *Water pollution sources, Alkalinity, Biological oxygen demand, Chemical oxygen demand, Heavy metals, Hydrogen ion concentration, India, Perch, Pollutant identification, Tilapia, Toxicology.

Though no Hg is utilized in the production process of a chlor-alkali plant, Hg is used as a cathode in the electrolytic process and some losses are inevitable. A toxicity assessment was performed on the effluent from a chlor-alkali factory in Ganjam, Orissa, India, whose effluent contains Hg ranging up to 1.5 mg/L. Whether the Hg present in the effluent caused the toxicity and whether the toxicity involved some other parameters of the effluent

as well were also studied. Two freshwater fish, Anabas scandens and Tilapia mossambica, were selected for the toxicity study. It was found that chemical oxygen demand (COD), biological oxygen demand (BOD), Hg, alkalinity and pH all contribute to the toxicity of the plant effluent. Mean BOD and COD values were as high as 69+/-18 mg/L and 448+/-120 mg/L, respectively. The total Hg level was 0.68+/-0.46 mg/L, out of which 0.15+/-0.18 mg/L was present in soluble form. The pH (10.31+/-0.98) and the alkalinity (620+/-385 mg/L) values were also very high. The effluent was highly toxic: 90% of A. scandens and T. mossambica died at 60% and 50% of the effluent concentration, respectively. At concentrations of 80-100% effluent, both species of fish died with 5-10 min. Comparison of tests performed using controlled amounts of HgCl2 with the effluent toxicity indicated that the Hg present in the effluent did not play any vital role in determining the acute lethal effect of the effluent. The lowest concentration of Hg (in the form of HgCl2) resulting in 50% death was 1.2 mg/L, a concentration much higher than the effluent's Hg content. It is clear from this study that the effluent studied is not fit for disposal into any water body as it will be hazardous to aquatic life. (Hoskin-PTT)
W91-00210

SEASONAL CHANGES IN THE TESTES OF FISH PUNTIUS TICTO, AND THEIR RELATION TO HEAVY METAL TOXICITY.
Holkar Science Coll., Indore (India). Dept. of Zoology.
R. Pundir, and A. B. Saxena.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 288-293, August 1990. 1 tab, 8 ref.

Descriptors: *Acute toxicity, *Cadmium, *Fish, *Heavy metals, *Water pollution effects, Aquatic productivity, Cytology, Histology, Microscopic analysis, Seasonal variation, Toxicology, Trace metals.

Seasonal environmental changes interacting with internal rhythms, regulate seasonal reproductive activity in fish. Other environmental factors impinge on organism's receptors and through them affect the central nervous system, hypothalamus, pituitary and finally the gonads. This study was performed to observe seasonal changes in the testes of the fish Puntius ticto and their relation to heavy metal toxicity. To observe the effect of heavy metals on the seasonal variation in testes, the fishes were captured in the wild during various seasons, brought to the laboratory and kept in a sublethal concentration (26 mg/L) of cadmium acetate for a 96-hr period. Cd treatment in the months October to December, a period of spermatogonial proliferation, produced some abnormal cytology. Fish treated in the months February to April, the early stage of testicular maturation, showed degenerative changes in the testes. Cd treatment in the months April to June, the advanced stage of testicular maturation, exhibited deformed testicular structure and spermatocyte destruction. Fish treated in the months July to September, a phase of functional maturation of the spermatogenetic tissue, produced deformities of spermatocytes, spermatids and spermatozoa. It thus appears from the present study that testicular cycle of Puntius ticto is adversely influenced by the heavy metal (Cd) treatment. (Hoskin-PTT)
W91-00211

BIOACCUMULATION OF MERCURY AND ITS EFFECT ON PROTEIN METABOLISM OF THE WATER HYACINTH WEEVIL NEOCHETINA EICHHORNAE (WARNER).
Indian Inst. of Chemical Technology, Hyderabad. Biology Group.
M. S. Hussain, and K. Jamil.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 294-298, August 1990. 2 tab, 18 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Mercury, *Path of pollutants, *Water beetles, *Water hyacinth, *Water pollution effects, Amino acids, Animal metabolism, Enzymes, Feeding rates, Proteins, Trace metals.

Water hyacinth growth is kept under control by the weed eating weevils Neochetina eichhornae and N. bruchi. Water hyacinth plants are continuously subjected to contamination by Hg and other heavy metals, but little is known about the interaction of heavy metals/plants/insects. The present study was performed to examine the bioaccumulation of Hg through the food chain in N. eichhornae and its impact on the beetle's protein metabolism. Hyacinths were grown in the laboratory at concentrations of mercuric chloride of 25, 50 and 75 ppm for 1 week. Leaves were then analyzed and fed to the weevils for 1 week. After one week the uptake of Hg by the plants was about 70-75%. A concentration dependent accumulation of Hg in water hyacinth leaves was found over a period of one week. At 25 ppm the total Hg accumulated was 15.16 micrograms/100 mg of leaves in male insects and 14.81 micrograms/100 mg in females. A similar pattern of bioaccumulation was observed at 50 and 75 ppm. It was also observed that the feeding of insects declined as the Hg concentration increased in the plants, an apparent avoidance mechanism of the insect to the toxicant. Hg was seen to interfere in the normal protein metabolism of the weevils, resulting in lower total protein content, higher levels of free amino acids and higher levels of aminotransferases, enzymes known to increase in these under stress conditions. The changes were most significant at 25 ppm Hg, which may be due to the decreased feeding rates at higher Hg concentrations. (Hoskin-PTT)
W91-00212

GONADAL HISTOPATHOLOGY FOLLOWING NICKEL INTOXICATION IN THE GIANT GAURAMI COLISA FASCIATUS (BLOCH AND SCHNEIDER), A FRESHWATER TROPICAL PERCH.
Gorakhpur Univ. (India). Dept. of Zoology.
K. Nath, and N. Kumar.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 299-304, August 1990. 6 fig, 12 ref.

Descriptors: *Acute toxicity, *Animal pathology, *Fish, *Heavy metals, *Nickel, *Perch, *Water pollution effects, Aquatic productivity, Histology, Microscopic analysis, Toxicity, Toxicology, Trace metals.

Very scanty data is available concerning the histopathological impact of nickel on fish tissues. In the present investigation, the impact of Ni on the histological architecture of gonads of both sexes of a freshwater tropical perch, Colisa fasciatus have been assessed. Adult, sexually-mature, gauramis were exposed to a sublethal concentration of nickel sulfate (64 mg/L) for 96 hr. Testis of the Ni-exposed fish exhibited marked degenerative alterations. There was general disorganization in the testicular lobules and spermatogenic activity was severely reduced. In female gouramis, ovaries presented significant alterations in the histological architecture, including the absorption of several oocytes. Thus sublethal Ni intoxication can result in significant reproductive impairment in this fish species. (Hoskin-PTT)
W91-00213

EFFECT OF CADMIUM ON BLOOD OF TILAPIA, OREOCHROMIS MOSSAMBICUS (PETERS), DURING PROLONGED EXPOSURE.
National Inst. of Occupational Health, Ahmedabad (India). Aquatic Toxicology Lab.
S. G. Ruparelia, Y. Verma, S. R. Salyed, and U. M. Rawal.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 305-312, August 1990. 2 fig, 3 tab, 17 ref.

Descriptors: *Blood, *Cadmium, *Chronic toxicity, *Heavy metals, *Tilapia, *Water pollution effects, Alkalinity, Cytology, Hardness, Toxicity, Toxicology, Trace metals.

Recent reviews on Cd have reported on acute and subacute effects on fish, mechanisms of toxicity, the role of toxicity-modifying factors and various sublethal effects, i.e. hematological and biochemical disorders. However, very little information is available on the subacute effects of Cd on the blood of fish exposed in hard water. The present study was carried out to observe the effects of Cd on the blood of tilapia (Oreochromis mossambicus) in hard and alkaline water to determine whether Cd causes changes in blood of fish kept in hard water in the same way that it causes changes in blood of fish kept in soft water. Tilapia were exposed to 0, 0.1, 1.0 and 10.0 ppm Cd for a period of 1, 3, 7, 14, 21 and 45 days in water at a hardness of 177.55+/-2.94 ppm. Hemoglobin, hemocrits and red blood cell counts all decreased significantly for fish exposed to Cd, with these abnormalities appearing earlier for higher Cd concentrations. Red blood cell indices such as mean cell volume, also were deranged for Cd-exposed tilapia. Macrocytic normochromic anemia with thrombocytosis, neutrophilia and cytological shift between large and small lymphocytes occurred in the studied fish during prolonged exposure to Cd in alkaline and hard water. These results were similar to those seen for other fish species in soft water. (Hoskin-PTT)
W91-00214

RECONNAISSANCE INVESTIGATION OF WATER QUALITY, BOTTOM SEDIMENT, AND BIOTA ASSOCIATED WITH IRRIGATION DRAINAGE IN AND NEAR STILLWATER WILDLIFE MANAGEMENT AREA, CHURCHILL COUNTY, NEVADA, 1986-87.
Geological Survey, Carson City, NV.
R. J. Hoffman, R. J. Hallock, T. G. Rowe, M. S. Lico, and H. L. Burge.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4105, 1990. 150p, 1 plate, 32 fig, 19 tab, 88 ref. Prepared in cooperation with the U.S. Fish and Wildlife Service and U.S. Bureau of Reclamation.

Descriptors: *Aquatic life, *Bottom sediments, *Irrigation effects, *Nevada, *Nonpoint pollution sources, *Water pollution sources, *Water quality, Ecological effects, Nutrients, Pesticides, Radioisotopes, Trace elements.

An investigation was initiated to determine whether irrigation drainage in and near the Stillwater Wildlife Management Area has caused or has potential to cause harmful effects on human health or fish and wildlife, or may adversely affect the suitability of water for beneficial uses. Samples of surface and groundwater, bottom sediment, and biota were collected from sites upstream and downstream from the Fallon agricultural area in the Carson Desert and were analyzed for potentially toxic trace elements, including selenium. Other analyses included radioactive substances, major dissolved constituents, and nutrients in water, and pesticide residues in bottom sediments and biota. In areas affected by irrigation drainage, concentrations of the following constituents commonly were found to exceed baseline concentrations or federal and state criteria for the protection of aquatic life or the propagation of wildlife: In water, arsenic, boron, dissolved solids, sodium, and un-ionized ammonia; in bottom sediments, arsenic, lithium, mercury, molybdenum, and selenium; and in biota, arsenic, boron, chromium, copper, mercury, selenium, and zinc. In some wetlands, selenium and mercury appear to be biomagnified whereas arsenic is bioaccumulated (uptake by biota is several orders of magnitude greater than the concentrations in water or food). Some radioactive substances were substantially higher at the downstream sites compared with upstream background sites, but the significance of this to wildlife is unknown at present. Pesticide contamination in bottom sediments and biota was insignificant. Adverse biological effects observed during this reconnaissance included gradual vegetative changes and species loss, fish die-offs, waterfowl disease epidemics, and persistent and unexplained deaths of migratory birds. (Author's abstract)
W91-00351

EFFECT OF HUMIC SUBSTANCES ON THE TOXICITY OF ALUMINUM TO ADULT RAINBOW TROUT, ONCORHYNCHUS MYKISS (WALBAUM).
Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
H. E. Witters, S. Van Puymbroeck, J. H. D. Vangenechten, and O. L. J. Vanderborght.
Journal of Fish Biology JFIBA9, Vol. 37, No. 1, p 43-53, July 1990. 2 fig, 3 tab, 25 ref. Commission of the European Communities DGXII contract no. EV40116B.

Descriptors: *Acid rain effects, *Acidic water, *Acute toxicity, *Aluminum, *Chemical speciation, *Humic substances, *Trout, *Water pollution effects, Acid lakes, Bioaccumulation, Blood, Chemical analysis, Fate of pollutants, Fish physiology, Gills, Hydrogen ion concentration, Path of pollutants, Toxicity, Toxicology.

Much of the mortality of freshwater organisms in acidified lakes is due to the combined adverse effects of both low pH and elevated Al concentrations. The present study was conducted to evaluate the toxicity of Al in the presence of widespread natural complexing ligands: humic substances. Some physiological parameters were measured in adult rainbow trout during a 10-day exposure to 180 micrograms/L Al in acid water (pH 4-7) with or without humic substances (10 mg/L). The fish were acclimatized to pH 5.0 for 7 days prior to the experimental treatments. Chemical analyses revealed that, in the presence of humic substances, 74-80% of the Al was organic bound, while in the absence of humic substances, most of the Al (98%) occurred in the inorganic form. Al bound to humic substances (130-150 micrograms/L) did not alter the plasma NaCl concentration, nor the hematocrit value, of rainbow trout during an exposure period of 10 days. This contrasts with the high death rate obtained within 2-3 days when most of the Al (175 micrograms/L) was in the inorganic form. The lethality was accompanied by a 25% decrease in the plasma concentration of NaCl and a doubling of the hematocrit value. Bulk analysis revealed that when the metal was present in inorganic forms the total Al content of the gills (75 micrograms Al/g wet weight) was 15 times higher than when it was present as bound to the humic substances. These experiments showed that the accumulation of Al at the gills was accompanied by physiological disturbances, both being a function of the chemical speciation of Al. (Author's abstract)
W91-00371

ECOTOXICOLOGY: CONTAMINATION OF THE RHINE BY THE SANDOZ CHEMICAL ACCIDENT IN BASEL (OKOTOXIKOLOGIE AM BEISPIEL DER RHEINVERSCHMUTZUNG DURCH DEN CHEMIE-UNFALL BEI SADOZ IN BASEL).
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
H. Guttinger, and W. Stumm.
Naturwissenschaften NATWAY, Vol. 77, No. 6, p 253-261, June 1990. 6 fig, 4 tab, 23 ref. English summary.

Descriptors: *Accidents, *Agricultural chemicals, *Rhine River, *Toxicology, *Water pollution effects, Chronic toxicity, Ecosystems, Fish.

A fire at a chemical manufacturing plant at Schweizerhalle (near Basel) in November 1986 and the subsequent release of toxic agrochemicals into the Rhine River is taken as a basis to discuss some problems and needs in ecotoxicological research. Especially serious is the lack of knowledge about chronic effects of mixtures of chemicals to individuals and whole ecosystems. There is an urgent need for generally applicable principles and concepts. A discussion of the relationship between toxic effects to fish, exposure time, and concentration provides some hints about the direction towards which research should proceed. Finally, eight theses pertaining to ecotoxicology summarize what can be learned from the analysis of a chemical spill. (Author's abstract)
W91-00384

EFFECTS OF WASTES ON THE OCEAN: THE COASTAL EXAMPLE.
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
J. E. M. Capuzzo.
Oceanus OCEAAK, Vol. 33, No. 2, p 39-44, Summer 1990. 3 fig.

Descriptors: *Coastal zone management, *Marine environment, *Ocean dumping, *Path of pollutants, *Waste management, *Water pollution effects, Bioconcentration, Environmental policy, Fate of pollutants, Food chains, Industrial wastes, Marine biology, Marine resources, Marine sediments, Municipal wastes, Toxic wastes, Waste disposal.

Extending from the shore to the edge of the continental shelf, the coastal ocean is one of the most productive ecosystems in the world, providing 50% of the world's fisheries harvests, and the breeding and nursery grounds of many commercially important species. It receives a wide range of contaminants from human society, including discharges from industrial and municipal wastes, dredged material, atmospheric fallout, polluted river discharge and deliberate marine disposal of industrial and municipal wastes. The distribution, fate, and effects of contaminants in coastal marine environments are governed by natural processes that influence their persistence and availability to marine animals. Bioaccumulation can lead to increased levels of contaminants higher in the marine food chain. they may lead to specific ecological changes resulting in the destruction of commercially important species, and the contamination of human food sources. Exposure standards for human health exist for only a few contaminants, such as polychlorinated biphenyls, mercury, and DDT. There is considerable variation in policy recommendations from different agencies regarding seafood safety issues, resulting from different methods of analysis and risk assessment, and in the inherent assumptions used in establishing ostensibly safe limits. The first step in developing wise management of ocean-disposal policy is to control more tightly the production and utilization of toxic chemicals, and reduce their amounts in wastes. To develop regulations for handling the unavoidable waste that remains, additional information is required: the physical processes, (specifically currents) that influence contaminant distribution; the chemical processes that influence availability, persistence and degradation of these materials in sediment and water; and the long-term biological effects that alter the stability of animal populations and the consequences of those effects on recreational and commercial fisheries. Only through multidisciplinary studies involving ecologists, toxicologists and oceanographers will we develop the understanding of the causal relationship between pollution and coastal degradation and develop predictive approaches to environmental monitoring that will, in turn, enable the development of environmentally sound waste-disposal options. (Hoskin-PTT)
W91-00385

DETECTING THE BIOLOGICAL EFFECTS OF DEEP-SEA WASTE DISPOSAL.
Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 5A.
W91-00386

RESPONSES OF ZOOPLANKTON AND ZOOBENTHOS TO EXPERIMENTAL ACIDIFICATION IN A HIGH-ELEVATION LAKE (SIERRA NEVADA, CALIFORNIA, U.S.A).
California Univ., Santa Barbara. Dept. of Biological Sciences.
L. A. Barmuta, S. D. Cooper, S. K. Hamilton, K. W. Kratz, and J. M. Melack.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 571-586, June 1990. 5 fig, 5 tab, 42 ref. California Air Resources Board Contract A6-184-32.

Descriptors: *Acid rain effects, *Acidification, *Aquatic life, *Lake acidification, *Lakes, *Plankton, *Sierra Nevada, *Water pollution effects, *Zooplankton, Altitude, Bioindicators, California, Competition, Copepods, Crustaceans, Indicators.

During the summer of 1987 an acidification experiment was conducted using large enclosures at Emerald Lake, a dilute, high-elevation lake in the Sierra Nevada, California, U.S.A. The experiment was designed to examine the effects of acidification on the zooplankton and zoobenthos assemblages of Sierran lakes. Treatments consisted of a control (pH 6.3) and pH levels of 5.8, 5.4, 5.3, 5.0 and 4.7; each treatment was run in triplicate. The experiment lasted 35 days. The zooplankton assemblage was sensitive to acidification. Daphnia rosea Sars emend. Richard and Diaptomus signicauda Lilljeborg decreased in abundance below pH 5.5-5.8, and virtually disappeared below ph 5.0 Bosmina longirostris (Muller) and Keratella taurocephala Ahlstrom became more abundant with decreasing pH, although B. longirostris was rare in the pH 4.7 treatment. These species might serve as reliable indicators of early acidification in lakes such as Emerald Lake. The elimination of D. rosea in acidified treatments probably allowed the more acid-tolerant taxa to increase in abundance because interspecific competition was reduced. Even slight acidification can therefore alter the structure of the zooplankton assemblage. In contrast to the zooplankton, there was no evidence that the zoobenthos in the enclosures was affected by acidification. (Author's abstract)
W91-00425

MACROFAUNA DISTRIBUTIONS AND SEDIMENT ANALYSES FROM THE BRUNSWICK, GEORGIA OCEAN DREDGED MATERIAL DISPOSAL SITE AND ENVIRONS.
Georgia Univ., Savannah. Marine Extension Service.
For primary bibliographic entry see Field 5E.
W91-00444

INTERIM: SELECTED CHEMICAL RESEARCH REPORTED BETWEEN CONFERENCES FIVE AND SIX.
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5F.
W91-00477

HEALTH EFFECTS OF DISINFECTANTS AND DISINFECTION BY-PRODUCTS: A REGULATORY PERSPECTIVE.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5F.
W91-00482

TRIHALOMETHANES: IS SWIMMING POOL WATER HAZARDOUS.
For primary bibliographic entry see Field 5F.
W91-00484

COMPARISON OF MUTAGENIC ACTIVITY OF CHLORINATED AQUATIC AND COMMERCIAL HUMIC SUBSTANCES.
Environmental Protection Agency, Cincinnati, OH.
F. C. Kopler, H. P. Ringhand, J. R. Meier, and W. Kaylor.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 147-158, 2 fig, 5 tab, 17 ref.

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Disinfection, *Humic substances, *Mutagens, *Water pollution effects, *Water treatment, Ames assay, Bioassay, Comparison studies, Humic acids.

One of the most important objectives of the US EPA research effort on the health effects of drinking water contaminants is to determine if adverse effects result from the presence of disinfection by-products in the finished water. The first attempts to produce samples of disinfection by-products to determine the potential health effects were per-

formed by concentrating organic fractions from representative waters before and after disinfection. The samples were further concentrated by freeze drying to volumes between 0.01 and 0.005 of the original concentration and filtered to remove precipitated salts. Two major problems were encountered with this approach: cost, and that the recovery of the compounds present in the water samples is not easily determined. When it became necessary to conduct long-term studies to address the health effects that may be associated with the by-products of disinfection, a decision was made to use a commercially available humic acid that could be dissolved and treated with disinfectant in the laboratory under reproducible conditions. The major advantages to using these laboratory-chlorinated humic acid solutions for biological testing instead of samples prepared by concentrating drinking water are that: (1) it is much less expensive; (2) chlorinated humic acid solutions can be prepared in sufficiently high concentrations for direct biological testing; (3) source water for any drinking water treatment plant changes constant, so even if the recovery efficiency for the organic compounds were known, this variable can prevent any dose certainty in administering to test organisms; and (4) samples prepared by chlorinating humic acid solutions remain in aqueous solution without a high salt concentration. Ames assay results obtained with the various chlorinated humic substances are essentially the same regardless of their sources. Results obtained with the chlorinated fulvic acid solution are very similar to those observed for concentrates of chlorinated drinking water and to tests on a known chlorine-humic acid by-product, MX. (See also W91-00476) (Lantz-PTT)
W91-00488

MUTAGENICITY OF THE NONVOLATILE REACTION PRODUCTS OF AQUEOUS CHLORINATION OF L-TRYPTOPHAN.
Florida Univ., Gainesville. Dept. of Food Science and Human Nutrition.
J. O. Yaw, W. B. Wheeler, and C. I. Wei.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 179-191, 1 fig, 4 tab, 30 ref. EPA Grant No. R-810416.

Descriptors: *Chemical reactions, *Chlorination, *Disinfection, *Tryptophan, *Water pollution effects, *Water treatment, Ames test, Chlorine compounds, Detritus, Fulvic acids, Humic acids, Mutagens, Toxicity.

During water chlorination, a number of halogenated and nonhalogenated by-products are produced from the reactions of free chlorine and decaying vegetation (fulvic and humic substances) and other biological materials present in water, including amino acids and proteins. Many chlorination reaction products and chlorinating agents such as hypocholorites have been shown to be mutagenic or carcinogenic. Amino acids are of particular concern. The nature of mutagens produced by aqueous chlorination of L-tryptophan was studied. Liquid-liquid extraction was used to extract reaction products following pH adjustments of the reaction mixture. The different fractions were tested using the Ames mutagenicity test. The neutral ethyl ether extract showed potent bacterial mutagenic activity and was further tested using sister chromatid exchange in Chinese hamster ovary cells. Gas chromatography/mass spectrometry was used to try to identify some of the by-products formed. Tryptophan reacted readily with different molar concentrations of aqueous chlorine, and the aqueous reaction products exhibited mutagenic activity in both tester strains at all levels used. The mutagens formed were not very stable. (See also W91-00476) (Lantz-PTT)
W91-00491

CARCINOGENICITY OF CHLORINATED ACETIC ACIDS.
Health Effects Research Lab., Cincinnati, OH. Toxicology and Microbiology Div.
A. B. DeAngelo, and L. P. McMillan.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 193-199, 1 fig, 4 tab, 15 ref. EPA Contract No. 68-03-3215.

Descriptors: *Acetic acid, *Carcinogens, *Chlorination, *Disinfection, *Drinking water, *Toxicity, *Water pollution effects, Dichloroacetic acid, Mammals, Public health, Trichloroacetic acid, Water treatment.

The discovery of haloacetic acids, dichloroacetic acid (DCA) and trichloroacetic acid (TCA), in finished drinking water at levels comparable to the concentration of chloroform, and the demonstration of their formation in the gut following ingestion of water containing sodium hypochlorite, increased concern about the health effects of chronic exposure to these chemicals. Liver enlargement is a characteristic response of laboratory animals exposed to xenobiotic chemicals and can result from a combination of cellular hyperplasia and hypertrophy. This enlargement represents an adaptive response to metabolic alterations induced by xenobiotics. Both the DCA and TCA increased liver weights in exposed mice, and the degree of enlargement correlated with the carcinogenicity of the acid. Results of the study indicate that: (1) DCA and TCA produced liver cancer in mice without prior initiation by ethylnitrosourea. DCA appeared to be a more potent carcinogen than TCA; (2) peroxisome proliferation did not appear to be a primary mechanism underlying the carcinogenicity of the chloroacteic acids; and (3) the role of cellular hyperplasia in DCA and TCA carcinogenesis was not determined and requires further study. (See also W91-00476) (Lantz-PTT)
W91-00492

COMPARISON OF DRINKING WATER DISINFECTANTS USING MUTAGENICITY TESTING.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-00493

MUTAGENIC ACTIVITY OF CONCENTRATED WATER EXTRACTS IN CULTURED MAMMALIAN CELLS AND DROSOPHILA MELANOGASTER.
Research Ltd., Ware (England). Genetic Toxicology Section.
P. Wilcox, S. Williamson, and R. Tye.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 239-260, 3 fig, 6 tab, 29 ref.

Descriptors: *Chlorination, *Disinfection, *Flies, *Mammals, *Mutagens, *Water pollution effects, *Water treatment, Bioassay, Chemical reactions, Drinking water, Toxicity.

Some raw water sources used for drinking abstraction contain mutagenic pollutants. Most of the activity in final drinking water is produced when it is disinfected with chlorine. The identity of the compounds responsible for most of the mutagenicity is still unknown, but they are believed to be reaction products between chlorine and naturally occurring organics in the water, such as humic, fulvic, and amino acids. Two studies were conducted using Drosophila. In a preliminary toxicity study, no significant difference in survival or fertility was seen between the vehicle control and flies treated with drinking water extracts. There was no obvious frequency of sex-linked recessive lethal mutations except in the flies treated with positive control (EMS). In study no. 2 the flies were allowed to feed on 1% sucrose solutions prepared using either meat or half-strength water extracts for three consecutive days. With this extended exposure period, some toxicity was observed in the flies exposed to the water extract, with only 74 of 150 flies surviving in the top dose group. Exposure to the water extract did not produce any significant increase in the frequency of sex linked mutations. This experiment demonstrates that drinking water extracts will also induce structural chromosome damage in human lymphocytes. Although clear evidence of clastogenic activity was observed, the results obtained in mammalian cell point mutation assays were not convincing. (See also W91-00476) (Lantz-PTT)
W91-00495

TOXICOLOGICAL EFFECTS ASSOCIATED WITH DRINKING WATER DISINFECTANTS AND THEIR BY-PRODUCTS.
Dugway Proving Ground, UT.
L. W. Condie.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 281-292, 3 tab, 43 ref.

Descriptors: *Chlorination, *Chlorine dioxide, *Disinfection, *Drinking water, *Toxicity, *Water pollution effects, Bioassay, Trihalomethanes, Water treatment.

The Toxicology and Microbiology Division of the Health Effects Research Laboratory (TMD-HERL) of the EPA has been conducting and sponsoring toxicology research to evaluate the possible adverse health effects of various disinfectants and their by-products. A research program at TMD-HERL has revealed that the drinking water disinfectant and disinfection by-product issue is more complex than previously thought. Initially, the primary concern was the production of trihalomethanes (THMs) from chlorination of drinking water. The solution to this problem was to use alternative disinfectants such as ClO2 that did not produce THMs. Additional problems have been identified with the disinfection practices of Cl2 and ClO2. A variety of chlorination by-products have been identified in addition to THMs. Many of the identified by-products have been demonstrated to possess mutagenic or carcinogenic properties. At levels as low as 50 ppm, ClO2 produces signs of hemolytic stress in animals. Because of concerns about the hemolytic and thyroid effects of ClO2 and ionized ClO2, it has been recommended that total residues of these products not exceed 1 ppm in finished drinking water. ClO2 at low doses (2 ppm) coupled with a marginal calcium diet produced elevations in serum cholesterol and evidence of atherosclerosis when pigeons received normal and high lipid diets. ClO2 at higher doses (15 ppm) was shown to elevate serum cholesterol only when the experimental animals were maintained on a marginal calcium, high lipid diet. If these findings are borne out in species such as man, serious consequences may result from disinfection of drinking water, because a high fat diet with low calcium consumption are common in the United States. (See also W91-00476) (Lantz-PTT)
W91-00497

ASSOCIATION BETWEEN CHLORINATED DRINKING WATER AND DECREASED SERUM HDLC IN TWO MONKEY SPECIES DURING DIETARY ATHEROGENIC STRESS.
Environmental Protection Agency, Cincinnati, OH.
J. P. Bercz, L. Jones, T. Mills, J. Stober, and J. Cicmanec.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 293-299, 3 tab, 18 ref.

Descriptors: *Chlorination, *Disinfection, *Drinking water, *Mammals, *Water pollution effects, Hyperlipidemia, Mutagens, Organic compounds, Toxicity.

Chlorine treatment of surface water as practiced in municipal water treatment plants is known to generate halogenic molecules from naturally occurring organics. Some such exogenous by-products of disinfection were shown to be mutagens and suspected carcinogens. The gastrointestinal fate of the highly reactive chlorine species is manifested in the endogenous (intra-alimetary) organifications of chlorine, giving rise to halogenated, and oxidized nutrients. Recently an association was found between water chlorination and increased serum cholesterol in Wisconsin communities. As an adjunct to EPA's ongoing clinical trial with chlorinated drinking water the hypothesis that subchronic consumption of superchlorinated water (0.17 and 0.84 mmol) influences hyperlipidemia induced in nonhuman primates by the atherogenic diet was tested. Additionally, the effect of hypochlorite (OCl) on serum lipids and lipoproteins was examined in the same monkey colony, in the absence of dietary stress. A hyperlipidemic diet was administered ad libitum and supplemented with fruit rations. Throughout the 0.84-mmol OCl period, water and food consumption were measured daily, and cholesterol and chlorine doses were computed. From the data, ingestion of chlorinated water apparently may have some as yet unknown exacerbating effect on the course of dietary hyperlipidemia. Because a zero chlorine-dose group was not available in this study, the possibility that the interpretation of the data is confounded by stress-induced lipoprotein changes cannot be ruled out. (See also W91-00476) (Lantz-PTT)
W91-00498

EFFECTS OF DRINKING WATER CHLORINE ON HUMAN LIPID AND THYROID METABOLISM.
Cincinnati Univ., OH. Coll. of Medicine.
R. G. Wones, L. Mieczkowski, and L. A. Frohman.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 301-308, 3 fig, 1 tab, 9 ref.

Descriptors: *Chlorination, *Chlorine, *Disinfection, *Drinking water, *Human physiology, *Water pollution effects, *Water treatment, Human pathology, Lipids, Public health, Thyroid.

Animal studies have shown that chlorine in drinking water can raise levels of plasma cholesterol and lower levels of serum thyroxine. These effects were most prominent when the animals were fed a calcium-deficient, high cholesterol, high-fat diet. Under these conditions, biologically and statistically significant effects were seen at concentrations of chlorine typically consumed by humans. The purpose of this study was to explore whether chlorine at concentrations typically found in drinking water affects human lipid and thyroid metabolism. Nineteen healthy men who were not receiving medications, who ranged in age from 24 to 62, were used in the study. Each subject served as his own control, and there was no separate, comparison control group that did not receive chlorine. While diet and other factors known to affect lipid and thyroid metabolism were very carefully controlled, one cannot be absolutely certain with this study design that the observed changes were not caused by effects of the diet or the protocol independent of the administration of chlorine. This controlled metabolic trial demonstrated that chlorine in drinking water at concentrations potentially consumed by humans may raise total plasma cholesterol and serum thyroxine. The changes are much smaller in magnitude than changes seen in animals and are of questionable clinical significance. Because this protocol was a pilot study for humans and was designed to maximize the chances of finding small differences, further research is necessary to better define and confirm these results. (See also W91-00476) (Lantz-PTT)
W91-00499

EFFECT OF DRINKING WATER CONTAINING CHLORINE AND MONOCHLORAMINE ON CHOLESTEROL AND TRIGLYCERIDE LEVELS IN THE LIVER OF THE PIGEON AND RABBIT.
Oak Ridge Research Inst., TN.
N. W. Revis, G. Holdsworth, and P. McCauley.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 309-317, 5 fig, 14 ref.

Descriptors: *Animal physiology, *Chlorination, *Disinfection, *Drinking water, *Liver, *Monochloramine, *Water pollution effects, *Water treatment, Birds, Cholesterol, Mammals, Triglycerides.

Previously, significant increases in plasma cholesterol in pigeons exposed to chlorine and monochloramine for periods of up to nine months were observed. However, in rabbits, plasma cholesterol remained normal following exposure to these disinfectants for similar periods. In both the pigeon and the rabbit liver, cholesterol increased significantly following 3 months of exposure to 15 ppm chlorine. During this same period, plasma cholesterol was significantly elevated following three months of exposure to 15 ppm chlorine. During this same period, plasma cholesterol was significantly elevated only in pigeons given these disinfectants. Following nine months of exposure, plasma cholesterol was elevated in the pigeon, but not in the rabbit. In contrast, liver cholesterol in the rabbit was significantly increased at 3 to 9 months of exposure, where as in the pigeon, cholesterol levels in the liver remained normal at nine months of exposure. These results suggest that chlorine affects the excretion of cholesterol from the liver in both species. Although liver cholesterol and triglycerides were increased following the exposure to chlorine and monochloramine, a clear dose response effect between these lipids and the drinking water disinfectants was not observed. To determine the effect of dietary calcium on liver cholesterol in the presence of the disinfectants, animals were given both a deficient and an adequate calcium diet. Results showed that calcium alone did not significantly affect liver cholesterol levels. However, liver cholesterol in the rabbit exposed to 6 ppm chlorine and monochlorine was higher when calcium was adequate. (See also W91-00476) (Lantz-PTT)
W91-00500

LONG-TERM EFFECTS OF CHLORINE-CONTAINING DISINFECTANTS ON PLASMA LEVELS OF CHOLESTEROL AND THYROXINE IN RABBITS AND PIGEONS.
Oak Ridge Research Inst., TN.
G. Holdsworth, and P. McCauley.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 319-328, 4 tab, 11 ref. EPA Contract No. 68-03-3201.

Descriptors: *Chlorination, *Disinfection, *Water pollution effects, *Water treatment, Animal physiology, Birds, Cholesterol, Mammals, Public health, Thyroxine.

To delineate the possible associations between chlorine in drinking water and plasma cholesterol, and to investigate the possible mechanisms by which these parameters may be linked, the long term (9 months) effects of the drinking water disinfectants chlorine and monochloramine on cholesterol levels of thyroxine (TH) were studied. Reduced T4 levels in plasma were shown to be associated with hypercholesterolemia in humans and in the white Carneau pigeon, and might be an important determinant of cardiovascular risk. Almost no statistically significant effects of drinking water disinfectants on plasma cholesterol and T4 levels were seen. Where they did occur (e.g. rabbits receiving 15 ppm chlorine and calcium-depleted at six months, or pigeons receiving 2 or 6 ppm monochloramine and calcium depleted at three months), the effects did not form part of a coherent dose-dependent response. However, the absence of any clear dose dependent, statistically significant effects of chlorine on plasma cholesterol levels in pigeons in the longer time period in these studies argues that any relationship between drinking water chlorine and hypercholesterolemia in this animal model may be extremely tangential and perhaps subject to adaptation. The possibility that thyroid hormones might be affected by chlorine intake had been considered because of earlier demonstrations of reduced T4 in response to drinking water chlorine in pigeons, and the concept that the metabolism of the thyroid might be a primary target for metabolic perturbations featuring the chlorine molecule. In these studies, as with plasma cholesterol, there were no dose dependent effects of drinking water disinfectants on plasma T4 levels and very few groups that differed significantly from controls. (See also W91-00476) (Lantz-PTT)
W91-00501

BIOCHEMICAL MECHANISMS OF IN VITRO CHLOROPROPANONE TOXICITY.
Health Effects Research Lab., Cincinnati, OH. Toxicology and Microbiology Div.
B. A. Merrick, J. R. Meier, C. L. Smallwood, D. L. McKean, and L. W. Condie.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 329-339, 3 fig, 2 tab, 15 ref.

Descriptors: *Biochemistry, *Chlorination, *Chloropropanone, *Disinfection, *In vitro tests, *Toxicity, *Water pollution effects, *Water treatment, Chemical reactions, Drinking water, Hydrogen ion concentration.

Toxicology studies performed on chloropropanone compounds have primarily focused on mutagenicity testing in which many chloropropanones are limited. Three chloropropanones capable of reacting directly with the sulfhydryl nucleophile, GSH, were tested in an in vitro buffer system without the need for metabolic activation. Reactions of alpha-haloketones with nucleophilic reagents, including sulfhydryls were used in various chemical synthetic and kinetic studies. The increasing rate of reaction of chloropropanones with GSH proceeding from pH 6 to 8 indicates a preferential interaction of chloropropanones with an ionized sulfhydryl group with a free pair of electrons, rather than the protonated form of GSH which predominates at a more acidic pH. In terms of in vivo toxicology by oral exposure to chloropropanones, the present study suggests that the direct cytotoxic action of these compounds in sufficient concentrations would make exposed tissues subject to contact necrosis. (See also W91-00476) (Lantz-PTT)
W91-00502

FISH HEPATOCYTE MODEL FOR INVESTIGATION OF THE EFFECTS OF TRIHALOMETHANES.
Environmental Research Lab., Narragansett, RI.
For primary bibliographic entry see Field 7B.
W91-00503

CHLORINE DIOXIDE DEPRESSES T3 UPTAKE AND DELAYS DEVELOPMENT OF LOCOMOTOR ACTIVITY IN YOUNG RATS.
Miami Univ., Oxford, OH. Dept. of Zoology.
S. A. Mobley, D. H. Taylor, R. D. Laurie, and R. J. Pfohl.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 347-358, 2 fig, 3 tab, 34 ref. EPA Grant CR-809618.

Descriptors: *Chlorination, *Chlorine dioxide, *In vitro tests, *Water pollution effects, *Water treatment, Animal physiology, Biochemistry, Chlorite,

Disinfection, Drinking water, Liver, Mammals, Thyroxine.

Chlorine dioxide has been suggested as an alternative to chlorine as a drinking water disinfectant. One advantage of using chlorine dioxide is that it has disinfectant abilities comparable to chlorine, but does not facilitate the formation of potentially harmful organohalides. An epidemiological study compared similar communities in which one community disinfected their drinking water with high levels of chlorine dioxide and the other used conventional disinfection methods. A positive correlation was shown between chlorine dioxide exposure, premature birth, and greater weight loss of newborns following birth. Administration of chlorine dioxide at 100 ppm in drinking water has resulted in depressed serum thyroxine levels in monkeys. Because the liver is the production site of the major thyroid hormone binding proteins, a change in liver activity would be expected if there was a substantial increase in the synthesis of hormone binding proteins. Increased (H)-thymidine uptake and analine hydroxylase activity in the liver have both been seen in rats following exposure to chlorine dioxide or chlorite in drinking water. Chlorite ions may be the active agent either directly or indirectly responsible for previously reported behavioral abnormalities following chlorine dioxide exposure. This suggestion is based on the knowledge that chlorite is the major breakdown product or metabolite of chlorine dioxide. It was found that indirect exposure to chlorine dioxide and chlorite results in similar behavioral changes. (See also W91-00476) (Lantz-PTT)
W91-00504

REVIEW OF RECENT EPIDEMIOLOGICAL STUDIES REPORTING ASSOCIATIONS BETWEEN DRINKING WATER DISINFECTION AND CANCER.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5F.
W91-00505

CASE-CONTROL STUDY OF COLON CANCER AND VOLATILE ORGANICS IN WISCONSIN MUNICIPAL GROUNDWATER SUPPLIES.
Wisconsin Univ.-Madison.
T. B. Young, M. S. Kanarek, D. A. Wolf, and D. A. Wilson.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 373-386, 1 fig, 8 tab, 8 ref. EPA Grant No. R808685, EPA Cooperative Agreement No. CR812252.

Descriptors: *Cancer, *Chlorination, *Disinfection, *Drinking water, *Water pollution effects, *Water treatment, *Wisconsin, Case studies, Dichloroethylene, New York, North Carolina, Public health, Tetrachloroethylene, Trichloroethene.

Studies in New York and North Carolina suggest that trihalomethanes (THMs) and other chlorination by-products were associated with colon cancer. To test this hypothesis specifically, a study of life-time THM exposure, based on estimates from a predictive model, was conducted using newly diagnosed colon cancer cases and controls. Although no risk was found for THM exposure, a small risk of exposure to chlorinated water persisted. The association between colon cancer and chlorinated drinking water could not be explained by chlorination by-products, but appeared to be due to an indirect association of both chlorination and colon cancer with municipal groundwater. When the relationship for municipal groundwater was explored further, elevated colon cancer risk was found for trichloroethylene, tetrachloroethylene, 1,1,1-trichloroethane, and 1,2-dichloroethylene. These four compounds are not chlorination by-products but can be considered indicators of groundwater contamination. To determine if the presence of groundwater contamination is a surrogate for other exposures, the covariation of VOCs with other factors was explored. No differences in demographics, such as ethnicity, or in community industrial character could be associated with the communities with higher-VOC wells. Similarly, no consistent pattern emerged from an exploration if the type of land use around community wells. Future studies will focus on other groundwater contaminants, including inorganic compounds. (See also W91-00476) (Lantz-PTT)
W91-00506

CASE-CONTROL STUDY OF MULTIPLE CANCER SITES AND WATER CHLORINATION IN IOWA.
Iowa Univ., Iowa City. Dept. of Preventive Medicine and Environmental Health.
C. F. Lynch, S. F. VanLier, and K. P. Cantor.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 387-398, 6 tab, 7 ref. EPA grant No. CR806301, NCI Grant No. NO1CP43200, EPA Grant No. CR813616.

Descriptors: *Cancer, *Chlorination, *Iowa, *Public health, *Trihalomethanes, *Water pollution effects, Bladder, Data acquisition, Drinking water, Human diseases, Hydrogen ion concentration, Pesticides, Volatile organic compounds, Water treatment.

Potential associations between chlorinated drinking water and cancer incidence are evaluated using two major components: a case control interview study, and drinking water studies. The case control study consists of 2800 cancer cases of a variety of cancers suspected as being associated with chlorinated drinking water in Iowa. Mailed out questionnaires were sent to individuals who verbally consented to participate. Completion of this component is not expected until Fall 1988, and is presently only 25% finished. The municipal water survey was begun in May 1987 and includes all utilities surveyed in 1979 plus 39 utilities serving towns in Iowa. Drinking water will be analyzed for trihalomethanes (THMs), six other volatile organic compounds (VOCs), total organic carbon (TOC), total organic halide (TOX), pesticides, pH, water temperature, total solids, and dissolved solids. Data from the National Bladder Cancer Study indicate an association between bladder cancer and chlorinated drinking water. The fact that the risk estimates increase with increasing duration of exposure to chlorinated drinking water supports the existence of an association with bladder cancer. A relationship with smoking appears important because the odds ratios calculated generally increase with increasing exposure to cigarette smoking and chlorinated drinking water. Due to small numbers of participants, the wide confidence intervals make definitive interpretation of this relationship difficult. (See also W91-00476) (Lantz-PTT)
W91-00507

CASE-CONTROL STUDY OF BLADDER CANCER IN MASSACHUSETTS AMONG POPULATIONS RECEIVING CHLORINATED AND CHLORAMINATED DRINKING WATER.
Brown Univ., Providence, RI. Dept. of Community Health.
S. Zierler, L. Feingold, R. A. Danley, and G. F. Craun.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 399-410, 5 tab, 22 ref. EPA Grant CR812080.

Descriptors: *Cancer, *Chlorination, *Drinking water, *Massachusetts, *Public health, *Water pollution effects, *Water treatment, Chloramination, Chloramines, Disinfection, Epidemiology, Human diseases.

A positive association was detected between usual and life-time chlorinated drinking water, and bladder cancer mortality. The bladder cancer association was highest for life-time residents of chlorinated drinking water communities relative to life-time residents of chloraminated drinking water communities. Some groundwaters have also been found to be contaminated with synthetic organics such as trichloroethylene, carbon tetrachloride, tetrachloroethylene, and 1,1,1-trichlorethane. These potential confounders were avoided in this study because the contrast of disease rates among groups defined as exposed and non-exposed to chlorinated by-products was measured only among consumers of surface water in which the disinfection strategy differed primarily by the addition of ammonia to one of the groups. This design achieved a high level of comparability in the distributions of correlates of the disinfection methods as well as characteristics of the study subjects that may have had bearing on bladder cancer risk. This study finds an increased frequency of bladder cancer mortality among life-time residents of communities receiving chlorinated drinking water. The findings confirm reports of an association between bladder cancer and chlorinated drinking water and suggests that the estimate of association may be stronger than those found in other studies. The study was confined to surface water sources to avoid potential noncomparability of water sources where exposure to chlorinated surface water has been compared to unchlorinated groundwater. Because almost all surface waters are disinfected, the index of no exposure to chlorinated by-products was chloraminated drinking water. The study does not address the effect of bladder cancer risk among users of chloraminated water relative to unchloraminated water. (See also W91-00476) (Lantz-PTT)
W91-00508

BLADDER CANCER, TAP WATER CONSUMPTION, AND DRINKING WATER SOURCE.
National Cancer Inst., Bethesda, MD.
K. P. Cantor, R. Hoover, P. Hartge, T. J. Mason, and D. Silverman.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 411-419, 4 tab, 10 ref.

Descriptors: *Cancer, *Chlorination, *Drinking water, *Public health, *Water pollution effects, *Water treatment, Bladder, Disinfection, Groundwater quality, Human diseases, Toxicology.

The primary focus here is the risk of bladder cancer as a function of fluid intake, especially tap water, and as a function of duration of residence served by chlorinated surface water. Most chlorinated surface sources have much higher levels of chlorination by-products than most chlorinated or nonchlorinated groundwater sources. The findings of this study suggest a correlation between chlorinated drinking water and bladder cancer risk. Among the criteria for judgement in assessing causality from epidemiological findings are: internal and external consistency, dose response gradients, coherence, high relative risks, and biological plausibility. With minor exception, the results are similar for men and for women and are consistent among the geographic areas. Dose-response patterns, both with regard to tap water intake and exposure duration would be difficult to explain by invoking the action of one or more confounding factors. Toxicological evaluations have demonstrated the genotoxicity and transforming activity of chlorination by-products in a variety of testing systems. The results suggest that about 12% of bladder cancers in this study population were caused by surface water contaminants. Among non-smokers the attributable risk was about 27%. There is clearly a need to have the finding from this study replicated by other investigators in different settings. (See also W91-00476) (Lantz-PTT)
W91-00509

SERUM LIPID LEVELS IN NEIGHBORING COMMUNITIES WITH CHLORINATED AND NONCHLORINATED DRINKING WATER.
Oak Ridge National Lab., TN.
E. A. Zeighami, A. P. Watson, and G. F. Craun.

IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 421-432, 2 fig, 4 tab, 20 ref.

Descriptors: *Chlorination, *Drinking water, *Human physiology, *Lipids, *Public health, *Water treatment, Human diseases.

Animal studies have produced some evidence indicating that chlorine intake in drinking water can effect serum lipids as well as have an effect on thyroid function. Clinical studies in humans has also found suggestive evidence of an effect of chlorine consumption on serum lipids. Potential changes in lipid levels caused by chlorine intake are important because of the near universal use of chlorination in public water supplies and the major role that lipid levels play in the risk of coronary artery disease and cerebrovascular disease. This study examined serum lipid levels in a human population consuming chlorinated and unchlorinated water of varying hardness. Because drinking water hardness, or total calcium intake, might be related to the same physiological characteristics and may exhibit physiological interaction with chlorine intake, a range of water hardness was desired in the choice of communities. For females, community mean levels of serum cholesterol (SV) were clearly higher in the chlorinated communities. For males, differences in community serum cholesterol levels are less apparent and not significantly different. Higher SC and low density lipoprotein (LDL) levels were found for study participants in communities with chlorinated drinking water, which suggests association between water chlorination and cholesterol levels. This is the first epidemiologic study to report this possible association. The possibility also exists that the observed association may have resulted from some unknown or undetermined variable in the chlorinated communities. The implications for cardiovascular risk are also unclear, because no association was found between high density lipoprotein (HDL) levels and water chlorination. Additional epidemiology studies in different populations, clinical studies, and experimental animal studies are required. (See also W91-00476) (Lantz-PTT)
W91-00510

FIELD EVALUATION OF THE EFFECT OF CHLORINATED TREATED SEWAGE ON SETTLEMENT OF OYSTERS (CRASSOSTREA VIRGINICA GMELIN) AND BARNACLES (BALANUS SP).

Virginia Inst. of Marine Science, Gloucester Point.
M. H. Roberts, B. B. Casey, C. S. Strobel, and E. Wilkins.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 435-452, 5 fig, 2 tab, 20 ref.

Descriptors: *Barnacles, *Chlorination, *Estuaries, *James River, *Oysters, *Wastewater treatment, *Water pollution effects, Biological studies, Chlorine, Field tests, New Haven Harbor, Toxicity, Wastewater outfall.

Larval stages of oysters (Crassostrea virginica) are extremely sensitive to stress. Laboratory studies show that bivalve embryos and larvae are among the estuarine organisms most sensitive to chlorine and chlorinated sewage. Chlorinated sewage added to estuarine water yielded chlorine-produced oxidant (CPO) concentrations between 0.01 and 0.03 mg/L inhibiting larval attachment; dechlorination can reverse this effect. In contrast, newly set spat (post metamorphosis) can tolerate at least 0.5 mg/L in 4-d exposures suggesting significant improvement in tolerance of chlorinated water after metamorphosis. This field study was initiated to monitor larval set and spat survival and growth to verify whether severe impacts predicted from laboratory experiments are actually experienced near a sewage treatment plant. Differences between laboratory and field conditions necessitated such a study to properly interpret the laboratory results. During both years of the study, spat-fall was monitored intensively around a chlorinated sewage discharge to evaluate whether effects observed in the laboratory can be demonstrated in the field. During the second year, field experiments were performed to measure post-metamorphic survival and growth. The result of this study showed no measurable effect of chlorinated treated sewage on oyster larvae or barnacle settlement. Dramatic inhibition in spat-fall was observed in New Haven Harbor; chlorine produced oxidant (CPO) was elevated at the stations where spat-fall was inhibited, ranging from 0.27 and 0.33 mg/L CPO. These residuals are at least an order of magnitude above predicted and previously observed CPO concentrations at the James River study site. While no impact of CPO was detectable on initial settlement, there might still be significant effects on mortality and growth on young spat leading to reduced yields at stations near the discharge. (See also W91-00476) (Lantz-PTT)
W91-00511

POTENTIAL FOR ADAPTATION OF THE ESTUARINE COPEPOD EURYTEMORA AFFINIS TO CHLORINE-PRODUCED OXIDANT RESIDUALS, HIGH TEMPERATURE, AND LOW OXYGEN.

Maryland Univ. Baltimore County, Catonsville. Dept. of Biological Sciences.
R. M. Davis, and B. P. Bradley.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 453-461, 2 tab, 15 ref.

Descriptors: *Chesapeake Bay, *Chlorination, *Copepods, *Wastewater treatment, *Water pollution effects, Adaptation, Disinfection, Estuaries, Oxygen, Temperature.

Populations of the estuarine copepod Eurytemora affinis were exposed to chlorine residuals and to low oxygen levels. Chlorine is frequently encountered by the species as a whole, although the local impact may be considerable; lowered oxygen is encountered seasonally in temperate aquatic environments, but possibly not at critical levels in the case of Eurytemora. Temperature stress is experienced during the summer months by Eurytemora in the Chesapeake Bay. A study was conducted to compare the potential adaptation of Eurytemora affinis to chlorine residuals, high temperature. and low oxygen by measuring the tolerance of individual males and females and the genetic variation in tolerance to the three stressors. The following conclusions can be drawn as a result of this work: (1) females have a higher chlorine oxidant tolerance than males, but data for low oxygen and high temperature were ambiguous; (2) males show a tendency toward less genetic variation than females for all three tolerances; (3) potential for genetic adaptation is lower for chlorine oxidant tolerance than for low-oxygen or high-temperature tolerances; and (4) selection for low oxygen or high-temperature tolerance has not been shown to be specifically in one direction. (See also W91-00476) (Lantz-PTT)
W91-00512

TOXICITY AND FATE OF TOTAL RESIDUAL CHLORINE IN OUTDOOR EXPERIMENTAL STREAMS.

Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
R. O. Hermanutz, K. N. Allen, and S. F. Hedtke.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 463-477, 6 fig, 4 tab, 13 ref.

Descriptors: *Chlorination, *Chlorine, *Environmental effects, *Toxicity, *Wastewater treatment, *Water pollution effects, Aquatic animals, Bluegills, Catfish, Fish, Sucker, Trout.

Toxicity to freshwater aquatic life is usually expressed as the concentration of total residual chlorine (TRC). TRC can be a composite of chlorine forms, primarily free chloride (hypochlorous acid and hypochlorite ion) and combined chlorine (monochloramine, dichloramine, and trichloramine). Selected portions of a two year study are addressed including the toxicity to four fish species (bluegill, Lepomis macrochirus; channel catfish, Ictalurus punctatus; white sucker, Catostomas commersoni; and rainbow trout, Salmo gairdneri, of the downstream degradation of TRC in streams and diel changes in TRC concentrations within the streams. When chlorine was added as a single toxicant, TRC probably caused marginal effects in channel catfish. No effects were observed in the other three species at the highest concentrations tested for bluegills, white suckers and rainbow trout. When 3 mg/L total ammonia was added with chlorine, the TRC did cause effects on channel catfish at a concentration below the national criteria. These findings indicate that significant long-term toxicity differences do exist among TRC forms. (See also W91-00476) (Lantz-PTT)
W91-00513

CHLORINE SENSITIVITY OF EARLY LIFE STAGES OF FRESHWATER FISH.

Agency for Toxic Substances and Disease Registry, Atlanta, GA.
S. C. Tsai, J. S. Mattice, J. R. Trabalka, M. B. Burch, and K. B. Packard.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 476-489, 5 fig, 2 tab, 15 ref. EPA Interagency Agreement DOE 40-740-78, DE-AC05-84OR21400.

Descriptors: *Bioassay, *Chlorination, *Chlorine, *Ecological effects, *Fish, *Lethal limit, *Powerplants, *Toxicity, *Water pollution effects, Aquatic environment, Electric powerplants, Embryonic growth stage.

Elemental chlorine is widely used in electric powerplants to control aquatic organisms that attach to the condensor cooling system and the microfouling organisms that affect the efficiency of heat transfer from hot steam in the generator to cooling water flowing through the condensors. In a typical powerplant, about 220 kg of chlorine is flushed through the condensor cooling system daily and discharged into receiving waters. The major variable affecting the chlorine sensitivity of fish in this study was the life stage of the test fish. The embryonic stages are far less sensitive to chlorine than other life stages. The 10-hr-old hardened egg of common carp, with a 1-hr LC of 158 (128-213) mg/L in the original test medium, was the least sensitive life stage. The most sensitive life stage is the prolarvae. The data suggest that sensitivity of fish to chlorinated discharges may depend on the life stage that it is exposed. If data can be generalized, it appears that fish larvae, especially those just hatched, may provide the most appropriate stage for testing. The current chlorine criteria were based on 48-hr and 96-hr exposures. Although current data do not support quantification of differences in effects when exposure times are substantially shorter, such quantification is needed to support cost effective decisions regarding the assessment and control of chlorine in intermittent effluents. (See also W91-00476) (Lantz-PTT)
W91-00514

ACUTE TOXICITY, SUBLETHAL EFFECTS, AND BIOCONCENTRATION OF CHLORINATION PRODUCTS, VIRUSES, AND BACTERIA IN EDIBLE SHELLFISH: A REVIEW.

South Carolina Univ., Columbia. School of Public Health.
G. I. Scott, W. P. Davis, J. M. Marcus, T. G. Ballous, and J. A. Dahlin.
IN: Water Chlorination: Chemistry, Environmen-

tal Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 491-518, 7 tab, 79 ref.

Descriptors: *Bacteria, *Chlorination, *Literature review, *Sublethal effects, *Toxicity, *Viruses, *Wastewater treatment, *Water pollution effects, Bioaccumulation, Chlorine, Lethal limit.

Chlorination products were the only compounds identified in a review of published data (not bacteria or viruses) that were acutely toxic to shellfish; LC50 values ranged from 1 to 880,000 micrograms/L, with an LC50 value of 1 microgram/L in M. mercenaria larvae being the lowest LC value observed. Most chlorination products were moderately toxic to supertoxic for the edible shellfish species tested. Published studies on the sublethal effects of chlorination products and bacteria indicate that the lowest chlorine concentration causing sublethal effects was 5 micrograms/L, whereas 1000 total coliform bacteria/100 ml was the lowest bacteria density causing sublethal effects. No studies were identified using sublethal effects of viruses in edible shellfish. Uptake/depuration rate kinetic studies for chlorination products, bacteria and viruses indicated: (1) a significant uptake of viruses from food, sediments and water; (2) a significant uptake of chlorination products from water; and (3) a significant uptake of bacteria from water. These studies generally indicate only slight bioconcentration potential for chlorination products in water and viruses in sediment. Much higher bioconcentration potentials were observed for shellfish exposed to viruses in food and water and from bacterial exposure in water. (See also W91-00476) (Lantz-PTT)
W91-00515

DEVELOPMENT AND CALIBRATION OF A MODEL FOR PREDICTING OPTIMUM CHLORINATION SCENARIOS FOR BIOFOULING CONTROL.
Miami Univ., Coral Gables, FL. Dept. of Civil and Architectural Engineering.
B. Al-Hoti, T. Waite, and W. Chow.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 521-534, 11 fig, 2 tab, 11 ref. EPRI Agreement No. RP2300-9.

Descriptors: *Biofouling, *Chlorination, *Electric powerplants, *Model studies, *Water pollution prevention, *Water treatment, Biological studies.

The need to minimize chlorine usage in powerplants has become a major factor in plant operation. Biofouling is the biological mediation of the deposition of organic and inorganic material on cooling system surfaces that results in a reduction of heat transfer capability in the condensors, and an increased drop in pressure in the turbines from the increase in frictional resistance. A modeling approach can provide the most efficient chlorination schedules based on chlorine concentration, contact time, and number of applications per day in seasonal conditions. Using these treatment schedules, chlorine treatment can maintain powerplant condensor-tube cleanliness, resulting in a reduction in operation costs. By choosing the most effective chlorine treatment scenario, it may be possible to keep cooling water total residual chlorine concentration in the discharge within EPA guidelines. The model presented has been tested on a limited number of powerplants. More testing should be done using the model to refine its predictability. For plants where the model has been used, it has always predicted fouling correctly. Beside predicting the presence of fouling in the condensor, which is the model objective, it also correctly predicted the amount of fouling that could be expected. (See also W91-00476) (Lantz-PTT)
W91-00516

MANGANESE DEPOSITION IN CHLORINATED POWER PLANT COOLING WATER.
Public Service Electric and Gas Co., Newark, NJ.
For primary bibliographic entry see Field 5F.
W91-00518

WATER CHLORINATION: IS THERE ENVIRONMENTAL RISK.
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5F.
W91-00550

MICROBIOLOGICAL PERSPECTIVE ON RISKS FROM WATER CHLORINATION.
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5F.
W91-00551

PESTICIDES AND WETLANDS OVERSEAS: A FRAMEWORK FOR MITIGATING ADVERSE IMPACTS.
California Univ., Berkeley. Graduate School of Public Policy.
For primary bibliographic entry see Field 5G.
W91-00570

PLASMA ELECTROLYTES, GILL ALUMINUM CONTENT, AND GILL MORPHOLOGY OF JUVENILE ATLANTIC SALMON (SALMO SALAR) AND BROOK TROUT (SALVELINUS FONTINALIS) INDIGENOUS TO ACIDIC STREAMS OF NOVA SCOTIA.
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
G. L. Lacroix, D. J. Hood, C. S. Belfry, and T. G. Rand.
Canadian Journal of Zoology CJZOAG, Vol. 68, No. 6, p 1270-1280, June 1990. 5 fig, 4 tab, 60 ref.

Descriptors: *Acid rain effects, *Aluminum, *Nova Scotia, *Salmon, *Toxicity, *Trout, *Water pollution effects, Acid streams, Animal pathology, Blood, Electrolytes, Fish physiology, Gills, Ions, Tissue analysis.

Plasma electrolytes and gill aluminum (Al) concentrations were determined and gill morphology and histology were examined in Atlantic salmon (Salmo salar) parr and brook trout (Salvelinus fontinalis) from feral populations in acidic streams of southwest Nova Scotia. Plasma sodium (Na) and chloride (Cl) ion concentrations were lowest in fish from streams with the lowest pH levels, but there were no correlations between plasma Na(+) or Cl(-) and exchangeable Al concentrations in streams for both species. Gill Al increased exponentially with increasing exchangeable Al in water, but was less than 100 micrograms/g dry weight in both species. There were no correlations between plasma Na(+) or Cl(-) and gill Al for both species, and plasma Na(+) and Cl(-) were ultimately linked to low pH. Scanning electron microscopy of gills showed normal primary and secondary lamellae, with few signs of fusion or hyperplasia, only a slight amount of mucus, regular chloride cell crypts, and epithelial cells with distinct microridges. Histology of gill sections showed few lesions in the primary lamellae but some focal histologic lesions in the secondary lamellae of greater than 50% of fish, regardless of ambient pH or Al concentration. The histopathology included hypertrophy of individual epithelial, mucous, and chloride cells, clubbing of tips of secondary lamellae, and localized epithelial hyperplasia. These features were focal and not comparable to the extensive morphological changes of histologic lesions usually attributed to high Al concentrations at low pH. Dissolved organic carbon concentrations greater than 5 mg/L in the acidic streams apparently afforded protection against Al effects at concentrations of at least 360 micrograms total Al/L. (Author's abstract)
W91-00616

INFERRED EFFECTS OF LAKE ACIDIFICATION ON DAPHNIA GALEATA MENDOTAE.
Ontario Ministry of the Environment, Sudbury.
W. Keller, N. D. Yan, K. E. Holtze, and J. R. Pitblado.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1259-1261, August 1990. 2 fig, 1 tab, 27 ref.

Descriptors: *Acid lakes, *Acid rain effects, *Canada, *Daphnia, *Toxicity, *Water pollution effects, Air pollution effects, Baseline studies, Bioassay, Biomass, Crustaceans, Hydrogen ion concentration, Lethal limit, Mortality, Population exposure, Regional analysis, Sulfur.

Large numbers of Canadian Shield lakes have been acidified by the atmospheric deposition of anthropogenic sulfur. Demonstrations of widespread biological effects of acidification have been greatly hampered by the general absence of observations of the occurrence or abundance of important, ubiquitous species in large numbers of lakes ranging widely in acidity, coupled with laboratory determinations of lethal acid thresholds for these species. In this report, determination of the lethal acid threshold of Daphnia galeata mendotae Dirge, a large, ubiquitous, planktonic crustacean, was coupled with results of extensive lake surveys, to examine if the acidification of lakes in Ontario has resulted in widespread losses of daphnia. Daphnia were collected in zooplankton surveys from four areas of Ontario, spanning a wide range in sulfur deposition regimes. This zooplankton occurred in 44 to 92% of the lakes with pH greater than 6.0 in each data set, and it was absent from virtually all lakes with pH less than 5.5. The biomass of D. galeata mendotae in the lakes assayed was significantly ($P < 0.05$) correlated with pH. In laboratory tests, the 4-day LC50 pH values ranged from 5.69 to 5.98 and were not significantly different; pooling the data yielded a LC50 pH of 5.85. The data strongly suggest that widespread damage to D. galeata mendotae populations has occurred as a result of anthropogenic influences, i.e., elevated sulfur emissions in North America. This damage commences at comparatively low levels of acidity, near or even above pH 6.0. It is estimated that there are at least 19,000 lakes that now have pH levels less than 6.0 in Ontario. (VerNooy-PTT)
W91-00626

FATE OF AQUATIC AND WETLAND HABITATS IN AN INDUSTRIALLY CONTAMINATED SECTION OF THE ELBE FLOODPLAIN IN HAMBURG.
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
For primary bibliographic entry see Field 5B.
W91-00648

OCCURRENCE OF HYPOLIMNETIC BLOOMS OF THE PURPLE SULFUR BACTERIUM, THIOPEDIA ROSEA, AND THE GREEN SULFUR BACTERIUM, CHLOROBIUM LIMICOLA, IN AN AUSTRALIAN RESERVOIR.
University of New England, Armidale (Australia). Dept. of Resource Engineering.
R. J. Banens.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 41, No. 2, p 223-235, 1990. 6 fig, 2 tab, 33 ref.

Descriptors: *Australia, *Bacteria, *Eutrophic lakes, *Limnology, *Reservoirs, *Sulfur bacteria, *Water pollution effects, Anaerobic conditions, Chlorophyll, Hypolimnion, Light quality, New South Wales, Puddledock Reservoir, Seasonal variation, Transparency, Turbidity.

Seasonal blooms of green and purple sulfur bacteria were found in the anoxic hypolimnion of Puddledock Reservoir, a small, eutrophic water-supply reservoir in northeastern New South Wales. The blooms were dominated by the green sulfur bacterium Chlorobium limicola and were sometimes overlain by a bloom of the purple sulfur bacterium Thiopedia rosea. The generally formed a plate just below the oxycline at a depth of between 4 and 6 m in the shallow, sulfuretted, nutrient-rich hypolimnion. The blooms increased in density from about mid summer until holomixis, when the return

to oxygenated conditions killed the sulfur bacteria. Maximum bacterial chlorophyll levels varied with the light regime, but typically reached 250 microgram/L, although the maximum recorded value was 410 microgram/L. The Secchi transparency during summer stratification was variable, but was typically around 1.2 m, with extremes ranging from 4.5 m on one occasion to as low as 0.8 m for an extended period as a result of epilimnetic algal levels of 40 microgram/L chlorophyll. Gilvin (g440) levels during these bacterial blooms always were less than 2.5/m. Sulfur bacteria were absent during one summer; this was attributed to a dramatic change in the light regime as a result of a major inflow event, which resulted in a Secchi depth of 0.75 m associated with very high gilvin levels of 7.5-11.0/m and high inorganic turbidity levels. The result would have been a very dim red light regime in the hypolimnion. (Author's abstract)
W91-00652

RELATIONSHIPS BETWEEN ACIDITY AND BENTHIC INVERTEBRATES OF LOW-ORDER WOODLAND STREAMS IN THE ADIRONDACK MOUNTAINS, NEW YORK.
Syracuse Univ., NY. Dept. of Civil Engineering.
M. E. Smith, B. J. Wyskowski, C. M. Brooks, C. T. Driscoll, and C. C. Cosentini.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1318-1329, July 1990. 10 fig, 3 tab, 47 ref.

Descriptors: *Acid rain effects, *Acid streams, *Benthic fauna, *Invertebrates, *New York, *Species diversity, *Water pollution effects, Adirondack Mountains, Animal populations, Aquatic insects, Ecology, Mountain streams.

Benthic invertebrates were collected during January, April, July, and October 1985 from three low-order woodland streams in the Adirondack Mountains, New York to evaluate relationships between acidity and stream invertebrates. Total invertebrate generic richness, generic diversity, Ephemeroptera density and richness, collector-gatherer richness, and scraper density and richness were positively correlated with stream pH. Ephemeroptera and Naididae (Oligochaeta) were absent from the acidic sampling site. Enchytraeid oligochaetes and Turbellaria were collected at all sites, but in significantly higher densities at the acidic site. Elmid beetles (Optioservus ovalis, Oulimnius latiusculus, and Promoresia tardella), mayflies (Cinygmula and Baetis), and caddisflies (Glossosoma, Apatania, and Micrasema) were abundant at the sites where the pH was highest and were absent from other sampling locales. Total invertebrate density was not decreased at the acidic site when compared with most other sampling sites. Multiple regression analyses revealed that pH and benthic organic matter were the two most important measured stream parameters in describing the variance of invertebrate communities in the three study streams. (Author's abstract)
W91-00657

PHYTOPLANKTON COMMUNITIES OF LAKES EXPERIMENTALLY ACIDIFIED WITH SULFURIC AND NITRIC ACIDS.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. L. Findlay, and S. E. M. Kasian.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1378-1386, July 1990. 9 fig, 2 tab, 27 ref.

Descriptors: *Acid lakes, *Acid rain effects, *Lake acidification, *Limnology, *Nitric acid, *Ontario, *Species diversity, *Succession, *Sulfuric acid, Biomass, Chrysophyta, Cyanophyta, Diatoms, Dinoflagellates, Ecology, Seasonal variation.

Additions of sulfuric acid to the South Basin and nitric acid to the North Basin of Lake 302 (Experimental Lakes Area, Ontario) caused major change in the phytoplankton communities. The basins were separated by a nylon-reinforced vinyl sea curtain. In the South Basin, below pH 5.6, species composition shifted from chrysophycean dominance to one of Dinophyceae. Diatoms and cyanophytes were eliminated below pH 5.3. Phytoplankton species diversity decreased as pH decreased. Total epilimnetic biomass was unchanged, except in the late fall, when entrainment of dense layers of hypolimnetic species caused increases. The assemblage of the North Basin changed immediately upon additions of HNO3 to resemble systems experimentally fertilized with N. Chrysophycean dominance gave way to chlorophytes and dinoflagellates. Once pH decreased below 6.0, diatoms and cyanophytes were eliminated from assemblage, as in the South Basin. Phytoplankton species diversity decreased, but total epilimnetic biomass remained unaffected. (Author's abstract)
W91-00659

RESPONSE OF A BROOK TROUT (SALVELINUS FONTINALIS) POPULATION TO A REDUCTION IN STREAM BENTHOS FOLLOWING AN INSECTICIDE TREATMENT.
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
D. P. Kreutzweister.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1387-1401, July 1990. 7 fig, 10 tab, 47 ref.

Descriptors: *Brook trout, *Fish populations, *Invertebrates, *Ontario, *Stream biota, *Water pollution effects, Aquatic communities, Fish food organisms, Fish growth, Icewater Creek, Insecticides, Permethrins.

A forest stream (Icewater Creek, Ontario) was treated with permethrin to determine the response of brook trout to a reduction in the aquatic food resources following insecticide treatment. The treatment resulted in massive invertebrate drift and significant reductions in benthos, but did not produce trout mortality or evidence of unusual behavior. The density, population age structure, movement patterns, and condition of brook trough were not affected measurably by the permethrin treatment. The growth rates of 0+ and 1+ age-classes were significantly lower following the insecticide application than form the same age-classes of pretreatment years. This reduction in growth rate resulted in significantly smaller trout after treatment. A significant reduction in the growth of trout collected during the same period from a nearby untreated stream indicated that unusually high summer temperatures were at least partially, if not entirely, responsible for the reduced growth rate of treated fish. Growth rates returned to or exceeded pretreatment levels by the overwinter period of the pretreatment year. (Author's abstract)
W91-00660

INFLUENCE OF UPWELLINGS, STORMS, AND GENERATING STATION OPERATION ON WATER CHEMISTRY AND PLANKTON IN THE NANTICOKE REGION OF LONG POINT BAY, LAKE ERIE.
Ontario Hydro, Toronto. Research Div.
For primary bibliographic entry see Field 2H.
W91-00662

EFFECT OF FLUORIDE COMPLEXATION ON ALUMINUM TOXICITY TOWARDS JUVENILE ATLANTIC SALMON (SALMO SALAR).
INRS-Eau, Sainte-Foy (Quebec).
K. J. Wilkinson, P. G. C. Campbell, and P. Couture.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 47, No. 7, p 1446-1452, July 1990. 6 fig, 4 tab, 37 ref. Fisheries and Oceans Canada DSS Contract FP707-7-2356/01-XSK.

Descriptors: *Acid rain effects, *Aluminum, *Chemical interactions, *Fluorides, *Salmon, *Toxicity, *Water pollution effects, Acidic water, Bioaccumulation, Bioassay, Gills, Juvenile growth stage.

In 7-day semistatic bioassays, fluoride complexation attenuated Al toxicity to juvenile Atlantic salmon (Salmo salar; age 1+) and the accumulation of Al in gill tissue, but not to the extent predicted by the free-ion model of metal toxicity. Bioaccumulation and toxicity persisted even in the presence of an excess of the complexing ligand. An equilibrium model, involving the formation of a mixed ligan complex (F-Al-L-gill) at the gill surface, is proposed to explain this residual toxicity (L-gill = ligand at the gill surface). Exposure to Al, or to a combination of Al and F, led to a decrease in the plasma sodium levels even for sublethal conditions. Aluminum concentrations as low as 2 micromolar adversely affected the salmon. The similarity of the osmo-regulatory response to the H(+) ion, to Al(3+), and Al(F), suggested that the mechanisms of toxicity in the presence of fluoride did not differ markedly from that observed by previous workers for salmonid species exposed to moderately acidic media containing Al but without added fluoride. (Author's abstract)
W91-00663

PHOSPHORUS AND NITROGEN LIMITATION OF PHYTOPLANKTON GROWTH IN THE FRESHWATERS OF NORTH AMERICA: A REVIEW AND CRITIQUE OF EXPERIMENTAL ENRICHMENTS.
California Univ., Davis. Div. of Environmental Studies.
For primary bibliographic entry see Field 2H.
W91-00664

CYANOBACTERIA IN FISH PONDS.
Laboratoire d'Ichtyologie Generale et Appliquee, Paris (France).
For primary bibliographic entry see Field 2H.
W91-00665

LIMNOLOGICAL STUDIES OF FOUR POLLUTED PONDS IN AND AROUND DHAKA CITY WITH REFERENCE TO INDICATOR SPECIES.
Dacca Univ. (Bangladesh). Dept. of Botany.
M. Khondker, A. K. M. Nurul Islam, Z. N. Tahmida Begum, and S. Haque.
Bangladesh Journal of Botany BJBTB3, Vol. 19, No. 1, p 51-63, June 1990. 4 fig, 5 tab, 23 ref.

Descriptors: *Bioindicators, *Euglena, *Eutrophic lakes, *Limnology, *Water pollution effects, Algae, Bangladesh, Euglenophyta, Eutrophication, Fertilizers, Organic matter, Species composition.

Four ponds displaying various levels of pollution and located in the Dhaka City vicinity of Bangladesh were studied for twelve months for limnological characteristics and associated indicator organisms, in particularly, the euglenophyta. The ponds were slightly acidic to alkaline (pH 6.1-7.6) but showed a wide range of variation in electrolytic conductivity (75-1000 microS/cm). The variation in dissolved oxygen content was remarkable, i.e., anoxia to a vary high concentration of 17.77 mg O2/L. The bicarbonate alkalinity and CO2 concentration varied from 0.04 to 1.9 meq/L and 0.123 to 3.19 mg/L, respectively. The number of euglenoid species were higher in organically enriched ponds than the inorganically fertilized ones. Euglenoid algae was more dominant than zooplankton in late October due to higher levels of decaying organic matter. (Author's abstract)
W91-00672

EFFECTS OF NUTRIENTS AND WATER LEVELS ON SPECIES COMPOSITION IN PRAIRIE WHITETOP (SCOLOCHLOA FESTUCACEA) MARSHES.
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
For primary bibliographic entry see Field 2H.
W91-00674

HUMAN ACTIVITIES LEADING TO CONTACT WITH WATER IN A SCHISTOSOMIASIS ENDEMIC AREA, SOUTHWEST SAUDI ARABIA: PRELIMINARY OBSERVATIONS.
King Saud Univ., Riyadh (Saudi Arabia). Coll. of Medicine.
A. A. Al-Madani, and M. S. Omar.

Southeast Asian Journal of Tropical Medicine and Public Health SJTMAK, Vol. 21, No. 1, p 145-148, March 1990. 1 tab, 11 ref.

Descriptors: *Human diseases, *Infection, *Parasites, *Saudi Arabia, *Schistosomiasis, *Water pollution effects, Drinking water, Public health, Recreation, Swimming, Water use.

Methods of human infection by Schistosomiasis were investigated in Asir Province, Southwest Saudi Arabia. Transmission of schistosomiasis requires contact with infected water. Villages and streams were visited during working days and weekends for one year in the province. Observations of human activities were made at different times during the period between 06:00 and 18:00 hr on different days. Results of the observations were similar to those of other researchers who found that people of Asir Province contacted water containing Schistosomiasis during occupational, domestic, and recreational activities. During agricultural activities all family members usually expose their unprotected forearms and barefeet to water. During the transport of water, adult males usually contact water when they use hoses to get water from wells, streams, and water reservoirs of dams to fill up their trucks. People may use schistosomiasis-contaminated water from wells for drinking, cooking, bathing, and washing their clothes. Contaminated stream water may be contacted when bathing, or washing cars or clothes. Family members use contaminated water for swimming and wading, and ablution. Urination and defecation in streams by infected humans may be the main source of reinfecting water with schistosomiasis. (Geiger-PTT)
W91-00678

DEGRADATION OF A STREAM CROSSING THE CITY OF ADDIS ABABA, ETHIOPIA.
Addis Ababa Univ. (Ethiopia). Dept. of Biology.
T. Berhe, A. D. Harrison, and H. B. N. Hynes.
Tropical Freshwater Biology, Vol. 2, No. 1, p 112-120, 1989. 1 fig, 2 tab, 21 ref.

Descriptors: *Ethiopia, *Eutrophication, *Stream degradation, *Stream pollution, *Water pollution effects, Algae, Biochemical oxygen demand, High flow, Invertebrates, Nitrates, Organic pollutants, Phosphates, Seasonal variation, Species diversity.

Twenty stations along 13.9 km of a stream flowing through the high altitude urban area of Addis Ababa, Ethiopia, were sampled during the dry and wet seasons. The temperature increased slightly in the downstream direction, and nitrate, phosphate and biochemical oxygen demand increased very greatly, indicating a steady increase of generalized organic pollution. At the same time there were changes in the algal populations, and the invertebrate diversity declined. Clearly some species were susceptible to the degradation, while a few benefited. But in the lower reaches, even the least sensitive animals began to decline in numbers. The study, therefore, produced a list of taxa that may serve to indicate degradation of streams at high altitudes in East Africa. The dry and wet season samples differed, indicating that high water dilutes the pollution, although it increased degradation in clean stations, presumably by wash-in. The algal populations were much reduced by high water, as were the invertebrates. Some of the latter decrease may have been caused by relatively less effective sampling in the deep water, but it is certain that some taxa became more abundant during the rainy season. (Author's abstract)
W91-00680

ESTIMATION OF THE CRITICAL OXYGEN TENSION FOR AND RECOVERING CAPABILITIES OF RED TILAPIA (OREOCHROMIS NILOTICUS X OREOCHROMIS MOSSAMBICUS) HYBRIDS.
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. of Animal Production in the Tropics and Subtropics.
For primary bibliographic entry see Field 2H.
W91-00683

VEGETATIVE GROWTH OF SPIRODELA POLYRRHIZA AS AFFECTED BY MEDIUM CONCENTRATION, DAYLIGHT INTENSITY AND AGE.
Benin Univ., Benin City (Nigeria). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W91-00684

LEAD POISONING IN MAGPIE GEESE ANSERANUS SEMIPALMATA FROM INGESTED LEAD PELLET AT BOOL LAGOON GAME RESERVE (SOUTH AUSTRALIA).
Australian National Parks and Wildlife Service, Berri.
M. J. Harper, and M. Hindmarsh.
Australian Wildlife Research AWLRAO, Vol. 17, No. 2, p 141-145, 1990. 1 fig, 2 tab, 14 ref.

Descriptors: *Australia, *Bool Lagoon, *Heavy metals, *Lead, *Recreation impact, *Sediment contamination, *Toxicity, *Water birds, *Water pollution effects, Mortality, Water depth, Wetlands.

A high mortality of magpie geese, Anseranus semipalmata, was associated with the ingestion of lead pellets, which had accumulated in the sediment at the Bool Lagoon Game Reserve, South Australia. Receding water levels in the autumn of 1986 enabled the geese to feed in areas containing high densities of lead pellets. The goose population of 320 birds was reduced by an estimated 44% during this period. Post-mortem examination of the contents of the gizzards from 30 dead geese showed that 93% contained ingested lead pellets. Analyses of the blood from 34 sick and dying geese showed lead levels of between 5 and 34 mol/L. The death of these geese raises concern about lead poisoning in other waterbird species throughout Australia in similar wetlands to Bool Lagoon. (See also W91-00686) (Author's abstract)
W91-00687

RESISTANCE TO ANTIBIOTICS AND HEAVY METALS OF PSEUDOMONAS AERUGINOSA ISOLATED FROM NATURAL WATERS.
Malaga Univ. (Spain). Facultad de Ciencias.
A. De Vincente, M. Aviles, J. C. Codina, J. J. Borrego, and P. Romero.
Journal of Applied Bacteriology JABAA4, Vol. 68, No. 6, p 625-632, June 1990. 3 fig, 4 tab, 24 ref. WHO grant SPA-06-K.

Descriptors: *Antibiotics, *Bacterial physiology, *Fecal coliforms, *Heavy metals, *Path of pollutants, *Resistance, *Water pollution effects, Arsenic, Epidemiology, Mercury, Spain.

The resistance patters of Pseudomonas aeruginosa strains isolated from freshwater and seawater to different antimicrobial agents and heavy metals were investigated. Resistance in these environment is linked to the level of fecal pollution. All strains were resistant to ampicillin and tetracycline but sensitive to carbenicillin, amikacin, tobramycin, and colistin, and to the assayed concentrations of silver, cadmium, lead, and molybdenum. Resistance to gentamicin, sulfadiazine, mercury, arsenic, and chromium was variable, so their use as epidemiological markers was considered. There was a close relationship between the degree of pollution and the frequency of heavy metal resistant strains of Pseudomonas aeruginosa. The highest frequencies of resistance to mercury and arsenic were obtained from marine environments with little fecal pollution, where the highest incidence of multi-resistant strains was also observed. (Author's abstract)
W91-00698

MICROCYSTIN COMPOSITION OF AN AXENIC CLONAL STRAIN OF MICROCYSTIS VIRIDIS AND MICROCYSTIS VIRIDIS-CONTAINING WATERBLOOMS IN JAPANESE FRESHWATERS.
National Inst. for Environmental Studies, Tsukuba (Japan).
K. Kaya, and M. M. Watanabe.
Journal of Applied Phycology JAPPEL, Vol. 2, No. 2, p 173-178, June 1990. 2 fig, 3 tab, 14 ref.

Descriptors: *Algal growth, *Algal toxins, *Cyanophyta, *Eutrophication, *Japan, *Water pollution effects, Human diseases, Population dynamics, Proteins.

Toxic blooms of cyanobacteria are often involved in the poisoning of animals, and implicated in human health problems. Toxic cyclis heptapeptides (microcystin) in cells of an axenic clonal strain of Microcystis viridis were analyzed quantitatively. Cells from the logarithmic, stationary and death phases of batch culture contained 670, 618, and 372 microg. toxic heptapeptides per g dry cells., respectively. The toxic peptides of the cells from the stationary phase consisted of microcystin RR (65%), microcystin LR (22%), microcystin YR (10%) and microcystin LA (3%). The composition of the toxic peptides changed only slightly through the phases of batch culture. Toxicities and the toxic peptide contents of Microcystis viridis-containing waterblooms in Japanese waters were found to have toxic effects on mice after intraperitoneal injection. The toxic peptides in the samples were composed mainly of microcystin RR (50%) and microcystin LR (30%). (Author's abstract)
W91-00699

ARSENATE SENSITIVITY IN MARINE PERIPHYTON COMMUNITIES ESTABLISHED UNDER VARIOUS NUTRIENT REGIMES.
Goeteborg Univ. (Sweden). Dept. of Botany.
S. A. Wangberg, and H. Blanck.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 139, No. 1/2, p 119-134, July 10, 1990. 7 fig, 1 tab, 44 ref. National Swedish Environmental Protection Board Grant 5333071-5333076.

Descriptors: *Arsenic compounds, *Bioindicators, *Nutrient concentrations, *Periphyton, *Photosynthesis, *Toxicity, Algal physiology, Chlorophyll, Nitrogen, Phosphates.

The sensitivity of carbon dioxide fixation to arsenate was measured in marine periphyton communities established under different nutrient regimes in flow-through aquaria. An increase of the phosphate concentration in the incubation media from 0.1 to 0.8 microM did not cause any immediate changes in sensitivity to arsenate. However, after 72 h of phosphate enrichment, sensitivity to arsenate had decreased > 3000-fold (EC20 values increased from 0.3 microM to > 1 mM). Decreases in sensitivity to arsenate were also seen during natural and simulated upwelling episodes when both the nitrate and the phosphate concentrations increased. The sensitivity to arsenate correlated with the phosphorus status of the communities, measured either as total phosphorus or surplus phosphorus, but not with their nitrogen or chlorophyll contents. The role of internal or external competition between arsenate and phosphate may be important in possible mechanisms for the phosphate-dependent tolerance. The key role of nutrient prehistory in modifiying periphyton sensitivity to arsenate is stressed. The time of the year and current nutrient situation will affect the phosphorus status of the algae, and should therefore be considered when performing toxicity tests and when making hazard assessments for arsenate. (Author's abstract)
W91-00700

RAPID METHOD FOR ASSESSING GROWTH RATES OF CORAL IN RELATION TO WATER POLLUTION.
Glasgow Univ. (Scotland). Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W91-00705

COLONIZATION OF AMPHIPODS AND POLYCHAETES TO SEDIMENTS EXPERIMENTALLY EXPOSED TO OIL HYDROCARBONS.
Abo Akademi, Turku (Finland). Dept. of Biology.
E. Bonsdorff, T. Bakke, and A. Pedersen.
Marine Pollution Bulletin MPNBAZ, Vol. 21, No. 7, p 355-358, July 1990. 2 fig, 1 tab, 30 ref. Norwe-

gian Marine Pollution Research and Monitoring Programme grant FOH 204.

Descriptors: *Amphipods, *Animal physiology, *Hydrocarbons, *Oil, *Polychaetes, *Sediment chemistry, *Water pollution effects, Metamorphosis, Recruitment, Toxicity.

Settling and metamorphosis are generally considered to be the most critical phases in the development of marine benthic invertebrates. The harmful effects of pollution can be expected to be the most severe during recruitment of individuals to sedimentary bottoms. Field experiments using colonization trays with or without cover, and larger enclosures were used to investigate the effects of the water soluble fractions of oil hydrocarbons (Ekofisk Crude oil) on recruitment of zoobenthos to shallow soft bottoms. The experiments were performed in situ at 8 m depth off Bergen, Norway. The main macrofaunal immigrants (July to December, 1980) were amphipods (mainly Corophium bonelli) and polychaetes (mainly capitellids, cirratulids, orbinids, and spionids). Covered trays are lower colonization by polychaetes than open trays, but addition of low levels of oil hydrocarbons did not affect polychaete density. Corophium bonelli showed similar rates of colonization to open and covered trays, but the covered trays showed that exposure to oil had a negative effect on population density, especially on juveniles. The reduced density in the oil exposure treatment may have been due to reduced survival of the marsupial embryos, or increased swimming activity (escape reactions to the oil). Natural predations on the amphipods in the uncovered trays was high enough to mask any negative effect of exposure to oil. These experiments also show that even very low doses of the water soluble fractions of oil (30 to 40 microg/L) may cause significant effects on the recruitment of the marine benthic organisms. (Brunone-PTT)
W91-00707

REMARKS ON THE ZOOPLANKTON POPULATION STRUCTURE NEAR WASTEWATER OUTFALLS ON THE ROMANIAN SHORE OF THE BLACK SEA (REMARQUES SUR LA STRUCTURATION DES POPULATIONS ZOOPLANCTONIQUES DANS LES ZONES DES EMISSAIRES D'EAUX USEES DU LITTORAL ROUMAIN DE LA MER NOIRE).
Institutul Roman de Cercetari Marine, Constanta (Romania).
A. Petran.
Cercetari Marine: Recherches Marines CMARDQ, Vol. 19, p 55-72, 1986. 2 tab, 9 fig, 16 ref. English summary.

Descriptors: *Black Sea, *Population dynamics, *Romania, *Wastewater outfall, *Water pollution effects, *Zooplankton, Animal populations, Community structure, Dominance, Ecology, Species diversity.

Results are presented on the structural evolution of zooplankton communities in inshore waters of the southern part of the Romanian coast, close to industrial and domestic wastewater effluents. Two hundred and sixty samples were analyzed and the results were analyzed (diversity index, dominance index, species frequency) to show the consequences of eutrophication and local pollution on the structural pattern of zooplankton communities in shallow waters. Depletion of communities is expressed both by their qualitative and quantitative scarcity within the contact zone between the effluent fan and the receptor seawater mass and by the development of two of the most opportunistic species, Acartia clausi and Pleopis polyphemoides. Structural parameters depend significantly on seasonal influences during the whole cycle. For instance, in summer one or two species could form rich populations, often organized even at the monospecific level. (Author's abstract)
W91-00711

IMPACT OF HEAVY METALS ON THE PRIMARY PRODUCTION.
Alexandria Univ. (Egypt). Dept. of Oceanography.
A. N. Khalil, and A. M. Ibrahim.
Cercetari Marine: Recherches Marines CMARDQ, Vol. 19, p 189-203, 1986. 2 fig, 2 tab, 29 ref.

Descriptors: *Chlorophyll a, *Heavy metals, *Primary productivity, *Red Sea, *Water pollution effects, Cadmium, Lead, Nickel, Saudi Arabia, Sharm Abhur, Toxicity, Zinc.

The effect of different concentrations of some heavy metals (2 or 3 metals, with final total concentration of 4 ppb) on primary production was studied at two localities near Jeddah (Red Sea), by estimating chlorophyll a. Metal toxicity at low concentrations influenced the productivity of the phytoplankton according to the following order: Pb > Zn > Ni > Cd. More depression of phytoplankton productivity took place when Zn accompanied was present with another/other metal(s) in the media. Impact of heavy metals on the primary production at a sheltered area (Obhur Creek) was relatively higher than that observed at an exposed area (open sea). (Author's abstract)
W91-00713

COMPARATIVE STUDY OF TOXIC LEAD EFFECT ON GILL AND HEMOGLOBIN OF TILAPIA FISH.
Instituto Politecnico Nacional, Mexico City. Dept. de Farmacologia y Toxicolgia.
For primary bibliographic entry see Field 5A.
W91-00722

MECHANISM OF TOXICITY OF ZINC TO THE MARINE DIATOM NITZSCHIA CLOSTERIUM.
Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Fuel Technology.
J. L. Stauber, and T. M. Florence.
Marine Biology MBIOAJ, Vol. 105, No. 3, p 519-524, June 1990. 7 tab, 32 ref.

Descriptors: *Diatoms, *Heavy metals, *Toxicity, Copper, Detoxification, Glutathione, Metabolism, Nitzschia, Photosynthesis, Plant growth, Respiration, Ultrastructure, Zinc.

The effect of zinc on cell division, photosynthesis, ultrastructure, respiration, ATP levels, mitochondrial electron-transport chain (ETC) activity, total thiols, and glutathione in the marine diatom Nitzschia closterium (Ehrenberg) W. Smith was investigated. Although 65 microgram Zn/L halved the cell division rate, photosynthesis and respiration were unaffected by zinc concentrations up to 500 microgram Zn/L. Most of the Zn associated with the cells was bound at the cell surface, with only 3 to 4% of this extracellular Zn penetrating the cell membrane. Once inside the cell, Zn exerted its toxicity at a number of sites. Increased ATP production and ETC activity were observed in Zn-treated cells. Zinc also enhanced cellular thiols and total glutathione, and Zn toxicity was reversible by the addition of thiol compounds such as cysteine. Zinc-thiol binding may be a detoxification mechanism for the cell. It is suggested that increased ATP production may provide the energy required for increased glutathione synthesis at the expense of other energy-requiring processes including cell division. The mechanisms of toxicity of ionic Zn and copper to N. closterium differ. Whereas oxidation of thiols, particularly GSH, may be the primary toxic effect of copper, zinc-thiol binding may be a detoxification mechanism. (Author's abstract)
W91-00729

SEASONAL CHANGES OF THE ENVIRONMENTAL CONDITIONS IN DIMICTIC LAKES DIFFERING AS TO THEIR TROPHIC STATE (SEZONOWE ZMIANY WARUNKOW SRODOWISKA W JEZIORACH DYMIKTYCZNYCH O ROZNYM STOPNIU EUTROFIZACJI).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 2H.
W91-00735

INFLUENCE OF SEWAGE POLLUTION ON A ROCKY INTERTIDAL COMMUNITY DOMINATED BY THE MYTILID BRACHIDONTES RODRIGUEZI.
Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Buenos Aires.
J. J. Lopez Gappa, A. Tablado, and N. H. Magaldi.
Marine Ecology Progress Series MESEDT, Vol. 63, No. 2/3, p 163-175, May 29, 1990. 9 fig, 4 tab, 49 ref. National Council for Scientific Research and Technology PID Grant 035/88.

Descriptors: *Argentina, *Intertidal areas, *Mussels, *Wastewater pollution, *Water pollution effects, Benthic environment, Biomass, Chlorophyta, Marine environment, Outfall, Periphyton, Stratification.

The characteristic Brachidontes rodriguezi community was absent from the highly polluted intertidal area surrounding a sewage outfall at Quequen (Argentina). It began to recover in lower tidal levels with better water renewal and shorter desiccation periods. The chlorophyte Ulva lactuca was the most abundant organism at intermediate pollution levels, but reached its highest abundance in association with B. rodriguezi. The pulmonate limpet Siphonaria lessoni, the chlorophytes Cladophora sp. and Enteromorpha compressa, and bluegreen algae increased in the vicinity of the outfall. A decrease in epilithic community biomass in the highly polluted area could be inferred from changes in percent cover, stratification and bare substratum proportion. Highest diversity was reached at intermediate levels of pollution. Diversity decreased at higher levels due to low specific richness and also in relatively unpolluted areas due to space monopolization by B. rodriguezi. Therefore, sewage pollution could be regarded as a disturbance factor preventing space monopolization by the most successful competitor. Sewage effects on the benthic community were similar to the decrease in abundance observed towards upper intertidal levels. Community structure proved to be a better pollution indicator than seawater variables since it can be considered as reflecting an average of varying environmental conditions. (Author's abstract)
W91-00764

EFFECTS OF CHANGES IN SEWAGE POLLUTION ON SOFT-BOTTOM MACROFAUNA COMMUNITIES IN THE INNER OSLOFJORD, NORWAY.
Tromsoe Univ. (Norway). Inst. of Fisheries.
M. M. Aschan, and A. M. Skullerud.
Sarsia SARIA3, Vol. 75, No. 2, p 169-187, 1990. 10 fig, 3 tab, 34 ref, 3 append.

Descriptors: *Fjords, *Norway, *Path of pollutants, *Water pollution effects, Macroinvertebrates, Species diversity, Statistical analysis.

The macrobenthic fauna of Vestfjorden, inner Oslofjord was sampled in 1980 and 1985 at 19 stations in order to detect possible faunal changes following the start of a sewage treatment plant in 1982. The faunal data were analyzed by a variety of methods including diversity indices, log-normal distribution of individuals among species and classification and ordination analysis. The results show a decline in species number and abundance which may be related to increased pollution. However, the diversity and the evenness have increased. The area within a radius of 2-3 km from the outlet of the treatment plant shows clear pollution effects while the marginal areas show improved conditions. Although there was not a distinct pollution gradient according to distance to outlet for each station, the five station groups had a distribution pattern determined by distance to the point source and depth. The reason why the new discharge area of Vestfjorden does not show even more obvious changes in benthic fauna due to pollution is that the inner Oslofjord has been receiving sewage and polluted waters for a long time period. The macrobenthos in the fjord has established a 'second stage equilibrium' or 'neighborhood stability' where deposit feeders dominate and distinct pollution effects are not detectable. The intermediate levels of pollution maintain an increased diversity and a large number of species by ensuring that dominance by

any one species is only temporary and a stable climax is never reached. (Brunone-PTT)
W91-00788

IMPLICATIONS OF HEAVY METAL TOXICITY RELATED TO EDTA EXPOSURE.
Bundesgesundheitsamt, Berlin (Germany, F.R.).
H. H. Dieter.
Toxicological and Environmental Chemistry TXECBP, Vol. 27, No. 1-3, p 91-95, 1990. 11 ref.

Descriptors: *Drinking water, *Ethylenediamine tetraacetic acid, *Heavy metals, *Toxicity, *Water pollution effects, Binding affinity, Food additives, Pharmacodynamics, Pharmacokinetics, Public health.

Owing to its poor degradability, ethylenediamine tetraacetic acid (EDTA) can be found in relatively high concentrations in many drinking waters produced from surface waters and river bank filtrates. In a toxicological assessment, heavy metals found in these waters are present mainly in the form of their EDTA complexes whose chronic low-dose toxicity has not yet been adequately investigated. Moreover, the biochemistry, pharmacodynamics and pharmacokinetics of the EDTA molecule itself preclude at present a definitive answer as to its toxicological profile. Some recent biochemical data show that EDTA could intensify the renal toxicity of cadmium due to the higher binding affinity of this complexing agent for zinc. EDTA after single and high dosage is distributed not only extracellularly but it also enters the renal tubulus cells. In this form it is able to destabilize their Zn-thionein pool. The pharmacokinetic half-life for the excretion of intracellular EDTA is not known but it seems to be significantly longer than that of extracellular EDTA. Therefore, considering its limited metabolisation, the intracellular accumulation of EDTA under chronic exposure seems to be possible. Under such conditions, a destablization of the renal Zn-thionein pool could become toxicologically relevant due to the high avidity of EDTA for zinc ions. A simultaneous increase of the concentration of cytosolic free cadmium could be the consequence. Therefore, there is a need for a toxicological re-evaluation of EDTA whose admission as a food additive in some European countries is based on data obtained at least 14 years ago. (Author's abstract)
W91-00792

EFFECTS OF NICKEL ON DAPHNIA MAGNA DURING CHRONIC EXPOSURE AND ALTERATIONS IN THE TOXICITY TO GENERATIONS PRE-EXPOSED TO NICKEL.
Staatliches Amt fuer Wasser- und Abfallwirtschaft, Herten (Germany, F.R.).
A. Munzinger.
Water Research WATRAG, Vol. 24, No. 7, p 845-852, July 1990. 7 fig, 5 tab, 45 ref.

Descriptors: *Daphnia, *Nickel, *Sublethal effects, *Toxicity, *Water pollution effects, Chronic toxicity, Life cycles, Population exposure, Populations, Reproduction, Statistical analysis.

Daphnia magna was cultured at sublethal nickel concentrations. The mean life expectancy was significantly less when exposed to greater than or equal to 40 ppb Ni. Statistically significant reductions of the number of offspring, maximum body length of adults and of neonates were caused by greater than or equal to 80 ppb Ni. The length and brood size of the primiparous animals were significantly less when exposed to greater than or equal to 120 ppb Ni. The intrinsic rate of population growth (r) was inversely proportional to nickel concentrations. During seven successive generations exposed to 160 ppb Ni, both the mean life span and the length of primiparous animals decreased significantly with increasing time. The progeny of nickel pre-exposed generations exhibited no adaptation towards nickel except an altered reproduction pattern which induced an increase of r. After the transfer into nickel-free water, the progeny of nickel pre-exposed generations showed an increase of body length, mean life span, number of offspring, brood size and brood number as well as the maximum body length of neonates. However, the progeny of pre-exposed generations remained smaller than the progeny of an untreated generation. (Author's abstract)
W91-00808

SIMPLE CONTINUOUS-FLOW TOXICITY TEST SYSTEM FOR MICROSCOPIC LIFE STAGES OF AQUATIC ORGANISMS.
California Univ., Santa Cruz. Inst. of Marine Sciences.
For primary bibliographic entry see Field 5A.
W91-00814

TOXICITY OF 1,1,1-TRICHLOROETHANE AND TRICHLOROETHENE ON A MIXED CULTURE OF METHANE-OXIDIZING BACTERIA.
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5G.
W91-00832

TOLERANCE OF SCAPANIA UNDULATA (L.)DUM. TO FLUORIDE.
Wroclaw Univ. (Poland). Dept. of Ecology and Nature Protection.
A. Samecka-Cymerman, and A. J. Kempers.
Aquatic Botany AQBODS, Vol. 37, No. 2, p 163-170, July 1990. 6 tab, 6 ref.

Descriptors: *Aquatic plants, *Bioaccumulation, *Fluorides, *Toxicity, *Water pollution effects, Groundwater, Lethal limit, Liverworts, Mineralization, Plant growth, Plant physiology, Poland, Sudeten, Water chemistry.

Fluoride is a common ion in surface water and groundwater, usually occurring in low concentrations. Increased concentrations of fluoride may be provoked by fluorite mineralization. Studies were made of the aquatic liverwort Scapania undulata from 21 Sudeten streams in Poland. It was found that this species, containing from 10 to 652 mg/kg dry weight of fluoride, grows in water with fluoride contents from traces to 0.3 ppm. According to bioassays the lethal concentration of fluoride (48 h LC(100)) for S. undulata appeared to be 400 or 450 ppm, depending on the population from which the liverworts were chosen. Exposure to 100 ppm fluoride for 16 days may be recognized as harmless for S. undulata. This liverwort is characterized by an ability to accumulate fluoride whereby the accumulation capacity depends on the fluoride level in the water of the growing site. This was demonstrated by an increase of 21-67% of fluoride in plants cultivated in water with concentrations of 250 ppm fluoride. (Author's abstract)
W91-00835

EFFECTS OF LOW PH AND LOW CALCIUM CONCENTRATION ON THE PULMONATE SNAIL PLANORBELLA TRIVOLVIS: A LABORATORY STUDY.
Oakland Univ., Rochester, MI. Inst. of Biological Sciences.
R. D. Hunter.
Canadian Journal of Zoology CJZOAG, Vol. 68, No. 7, p 1578-1583, July 1990. 2 fig, 4 tab, 26 ref.

Descriptors: *Acid rain effects, *Acidification, *Mollusks, *Snails, *Water pollution effects, Calcium, Eggs, Growth rates, Hydrogen ion concentration, Juvenile growth stage, Laboratory methods, Mature growth stage.

Mollusks are among the groups of freshwater animals which are most sensitive to acidification. Freshwater pulmonate snails (Planorbella trivolvis) were maintained in the laboratory in stream water with manipulated pH and Ca(2+). Low pH treatments (4.6 and 4.7) resulted in significantly lower adult growth rates and reduced gross fecundity compared with circumneutral pH treatments (7.2 and 7.4) regardless of the Ca(2+) level. None of the eggs laid in low pH treatments hatched, mostly because of developmental arrest (gastrula or earlier). Eggs in low Ca(2+) treatments took longer to complete development and had a higher incidence of abnormality compared with eggs in the high pH, high Ca(2+) treatment. Juveniles that successfully hatched from the low Ca(2+) grew very little and all died within 100 days, whereas > 7.2% of those in the high Ca(2+), circumneutral pH treatment were alive at day 100, some of which had become adults and were laying eggs. This study suggests that both low pH (4.6) and low Ca(2+) (1-2 mg/L) are lethal to P. trivolvis, with embryos and juveniles showing much greater sensitivity than adults. Given the range of the two variables used in this study (1000-fold for H(+) and approximately 30-fold for Ca(2+)), pH has the greater negative impact and, when below 5.0, led to recruitment failure in P. trivolvis; a similar effect on other pulmonate species would be expected. Furthermore, a Ca(2+) concentration as low as 2 mg/L alone, regardless of pH, would be sufficient to cause recruitment failure by reducing juvenile survival. These data suggest that increasing Ca(2+) levels does not protect P. trivolvis from the effects of low pH. (Author's abstract)
W91-00838

RELATIONSHIPS BETWEEN COPPER CONCENTRATIONS IN LARVAE OF PLECTROCNEMIA CONSPERSA (CURTIS) (TRICHOPTERA) AND IN MINE DRAINAGE STREAMS.
Polytechnic South West, Plymouth (England). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W91-00859

HEALTH EFFECTS OF HAZARDOUS WASTE.
South Carolina State Dept. of Health and Environmental Control, Columbia. Bureau of Preventive Health Services.
C. W. Heath.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 3.17-3.27, 3 fig.

Descriptors: *Epidemiology, *Hazardous materials, *Hazardous waste disposal, *Public health, *Risk assessment, Hazard assessment.

Hazardous chemicals and the ways in which the health risks posed by exposure to waste chemicals are measured are addressed. Whatever the setting, risk assessment is critically dependent on three types of data: (1) data concerning the nature of potentially toxic exposure; (2) data concerning the existence and nature of disease or biologic abnormalities; and (3) data concerning the degree to which exposure and biologic abnormalities may be etiologically linked in any particular setting. In order to determine the health risks it is necessary to document the toxins present and to characterize the exposure setting; evaluate the chemical properties; measure the spread of contamination; and test exposed persons. Since different toxic chemicals can have quite different biologic effects, both as a result of differing chemical properties for individual target tissues and in relation to their doses and pathways of exposure, many different kinds of disease and biologic change need to be considered. Complete case ascertainment is as crucial as accurate case diagnosis. Epidemiologic investigations describe frequencies of illness in populations and relate those frequencies to various characteristics of those populations. Situations requiring assessment of possible hazardous-waste health effects can take either of two forms. One entails assessing the toxic potential of a known waste-disposal site and then seeking patterns of human illness which might result from site exposure. In the other the epidemiologist is called upon to assess an apparently unusual pattern of disease in a community and, in the process, to seek a possible environmental cause. It is also frequently necessary to extrapolate high-dose animal toxicologic data to low-dose human exposures and to use subclinical observations as a theoretical basis for predicting future human disease. (See also W91-00900) (White-Reimer-PTT)
W91-00908

5D. Waste Treatment Processes

IMPROVING THE SLUDGE CONDITIONING POTENTIAL OF MORINGA SEED.
Nigeria Univ., Nsukka. Dept. of Civil Engineering.
J. O. Ademiluyi, and R. M. Eze.
Environmental Management EMNGDC, Vol. 14, No. 1, p 125-129, January/February 1990. 3 fig, 23 ref.

Descriptors: *Digested sludge, *Moringa seeds, *Sludge, *Sludge conditioning, *Wastewater treatment, Chemical treatment, Chlorides, Filtration, Model studies.

In the search for a cheaper material to effectively condition sludge, oil-free moringa seed was prepared and tested. A Soxhlet apparatus was used to extract the oil from moringa seed (Moringa oleifera). The oil-free seed (marc) has been found to have higher conditioning potential than the ordinary moringa seed. (However, the traditional ferric chloride is still better sludge conditioner than moringa seed marc). For the digested domestic sludge used, optimum conditioning dosages were found to be 0.6, 0.80, and 1.10 percent of the total solids for ferric chloride, marc of the moringa seed, and ordinary moringa seed, respectively. Since little or no operational material is lost in the extraction process, the moringa seed marc is a promising conditioner in place of the ordinary seed. (Author's abstract)
W91-00028

ENERGY HEAD IMPLICATIONS OF THE INSTALLATION OF CIRCULAR FLAP GATES ON DRAINAGE OUTFALLS.
Liverpool Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W91-00068

UTILITY APPROACH TO STORMWATER MANAGEMENT.
Jones and Henry Engineers, Inc., Fort Wayne, OH.
For primary bibliographic entry see Field 4A.
W91-00104

UPGRADING THE OWL'S HEAD WASTEWATER TREATMENT PLANT.
Metcalf and Eddy of New York, NY.
A. N. Borowiec, and J. T. Miller.
Public Works PUWOAH, Vol. 121, No. 6, p 91-92, June 1990. 1 fig.

Descriptors: *New York, *Project planning, *Upgrading, *Wastewater treatment facilities, *Water treatment facilities, Aeration, Pumping plants, Secondary wastewater treatment, Settling basins, Sewers, Sludge digestion, Sludge treatment, Wastewater treatment.

Bound by the constraints of existing structures and systems that must provide continuous service during construction, large-scale upgrading projects often require extraordinary management efforts to meet the simultaneous objectives of onging operation and new construction. At the Owl's Head Wastewater Treatment Facility in Brooklyn, New York, a 14-year, $475-million rehabilitation and upgrading project is underway to change the treatment process from modified aeration to full secondary, thereby complying with the Clean Water Act and New York State environmental permits. Analysis of existing facilities and future needs yielded four conclusions: The facility's mechanical and electrical equipment required replacement; The pump and powerhouse structure could be salvaged with renovation; The six existing sludge digestion tanks (four primary digesters and two gas extractors) were not salvageable; and The aeration and settling tanks required replacement for the facility to meet full secondary treatment standards. Using these findings, New York City formulated a comprehensive program to develop a facility capable of meeting the current, more stringent treatment requirements. The plan provided for a new sludge processing complex, a renovated pump and powerhouse building, new primary and secondary settling tanks, new aeration tanks, a new and rehabilitated seawall, new outfall sewer, and new chlorination facilities. The public's ongoing participation has ensured that the inevitable construction difficulties have had a minimal impact on neighborhood life. The city has helped to develop and implement programs to aid delivery and construction, and subcontractors have responded to the often-demanding schedules of a major construction project. (Mertz-PTT)
W91-00107

OPTIMIZING POLYMER DOSAGE IN SLUDGE DEWATERING PROCESS.
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
H. W. Campbell, and P. J. Cresuolo.
Water Engineering and Management WENMD2, Vol. 137, No. 6, p 31-32, June 1990.

Descriptors: *Canada, *Polymers, *Sludge conditioning, *Sludge drying, *Wastewater treatment, Cost analysis, Costs, Dewatering, Economic aspects, Operating costs, Wastewater facilities.

The sludge conditioning controller is an innovative device that measures and adjusts dosages of polymer used in the sludge dewatering process every 30 seconds. Since large sewage treatment plants can spend thousands of dollars per year on polymer, the potential cost savings as a result of more efficient polymer usage are substantial. The development of the sludge conditioning controller evolved from applied research conducted at the Wastewater Technology Center, in Ontario, Canada. In 1986, the sludge conditioning controller was installed at the Guelph Water Pollution Control Plant where it successfully demonstrated a significant reduction in polymer usage. Polymer saving was calculated to be 24%. The sludge conditioning controller consists of two major subsystems: the sampling system and the central control panel. The sampling system consists of a tank, feed and drain pinch valves, three spray rinsing nozzles and the measurement head assembly. The measurement head includes the rheology sensor and its drive motor, a signal conditioning amplifier and a level sensor. The central control panel houses the microcomputer that receives the raw rheological measurements and calculates the parameters of interest and output control signal for the appropriate polymer pump controller. (Mertz-PTT)
W91-00112

MOVING SLUDGE.
Lockwood, Andrews and Newman, Inc., Dallas, TX.
J. Moseley.
Water Engineering and Management WENMD2, Vol. 137, No. 6, p 28-29, June 1990. 2 fig.

Descriptors: *Sludge drying, *Wastewater treatment, Dallas, Dewatering, Economic aspects, Environmental protection, Filter presses, Polymers, Sludge, Texas, Waste disposal, Wastewater disposal, Wastewater facilities.

Dallas Water Utilities treats almost 200 million gallons of wastewater each day. This wastewater is sent to one of two facilities, the Southside Wastewater Treatment Plant or the Central Wastewater Treatment Plant, where the solids are removed. The solids removed from the wastewater at both treatment plants are sent to the sludge dewatering facilities at the Southside plant. The liquid sludge is pumped onto belt filter presses where it is mixed with a polymer that coagulates the solids and separates it from the water. Programmable logic controllers, installed at each belt filter press, control belt speeds, tension, polymer and sludge pump speeds, polymer mixing energy and fluid levels. At the pug mill facility, the dewatered sludge is mixed with on-site granular soils prior to ultimate disposal in a dedicated 200-acre sludge-only landfill. Mixing in the pug mill facility is more economical than field mixing. It also uses approximately 50% less soil. To protect the environment and prevent contaminated groundwater migration, the monofill is surrounded by a 31-foot deep soil-slurry cutoff wall; levees protect the site from flooding, and groundwater monitoring wells encircle the entire site. (Mertz-PTT)
W91-00113

HIGH-SOLIDS CENTRIFUGES TURN OUT TO BE SURPRISE DEWATERING CHOICE.
Passaic Valley Sewerage Commissioners, Newark, NJ.
S. Lipke.
Water Engineering and Management WENMD2, Vol. 137, No. 6, p 22-24, June 1990. 3 fig.

Descriptors: *Centrifugation, *New Jersey, *Sludge drying, *Wastewater treatment, Dewatering, Filter presses, Odor control, Sludge, Wastewater facilities, Wet oxidation process.

The first step in implementing a land-based alternative to ocean dumping is to mechanically dewater the sludge. The Passaic Valley Sewerage Commissioners investigated methods to dewater sludge, both in the U.S. and by observing European technology. A wet-air oxidation system to condition the sludge for dewatering in recessed chamber filter presses, belt filter presses in conjunction with polymers for sludge conditions, and European technology that used high-solids centrifuges were considered. Centrifuges had several advantages over other technologies: they were totally enclosed, drastically reducing odors that needed to be treated and they operated without sprays or exposed sludge. Historically, though, they are known for rapid wear and high-moisture cakes. A life-cycle analysis of the alternatives showed that twice as many belt filter presses were needed as centrifuges to handle the same sludge volume. The filter-press facility would have been similar in size to a centrifuge dewatering facility, but the centrifuges needed much less of an odor-control system than either of the other alternatives. Soon after completion of the dewatering section of the Passaic Valley Sewerage Commissioners' Facilities Plan, they began the design of an Interim Dewatering Facility to meet a New Jersey State-mandated deadline for ending ocean dumping by March, 1991. The Interim plan will use the existing wet-air oxidation/filter press installation to dewater about 70% of the raw sludge production. The remaining sludge will be dewatered by 7 high-solids centrifuges. Start-up and testing of the facility will begin in January 1991. (Mertz-PTT)
W91-00114

USE OF STATISTICAL METHODS IN INDUSTRIAL WATER POLLUTION CONTROL REGULATIONS IN THE UNITED STATES.
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5G.
W91-00125

CONTINUOUS EFFLUENT CONSENTS: MODELLING AND COMPLIANCE TESTING.
WRc Engineering, Swindon (England).
For primary bibliographic entry see Field 5G.
W91-00126

STATISTICS-BASED SYSTEM FOR TREATMENT PLANT OPERATION.
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
P. M. Berthouex, W. Lai, and A. Darjatmoko.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 247-269, November 1989. 11 fig, 1 tab, 55 ref. USEPA Assistance Agreement CR-812655-01-0.

Descriptors: *Computer programs, *Information systems, *Statistical models, *Statistics, *Wastewater treatment, Computers, Wastewater facilities, Wastewater management.

The mission of a wastewater treatment plant is to transform raw sewage into an effluent that meets permitted discharge standards. Research is being conducted to develop a convenient computer system to improve everyday operation and control of the wastewater treatment process. The goal is to

help the operator detect the problems in the process and to select appropriate control actions. The system, known as STATEX, comprises subsystems for a data base management, data analysis including several statistical methods, and an expert advisory system. The statistical methods investigated include construction of external reference distributions, computation of moving averages, graphical methods, discriminant functions for early detection of upsets, and several kinds of control charts. The latter two methods are still under development and are not built into the system. Reference distributions are used to help define the fuzzy terms such as high and low for the conditions of the variables involved in the expert system control rules. The system is written in dBase-III and Lotus-123 and has a user-friendly interface for the communication between the user and the system. (Author's abstract)
W91-00129

STATE ESTIMATION IN WASTEWATER ENGINEERING: APPLICATION TO AN ANAEROBIC PROCESS.
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
R. M. Jones, J. F. Macgregor, and K. L. Murphy.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 271-282, November 1989. 6 fig, 13 ref, append.

Descriptors: *Model studies, *Statistical analysis, *Statistical models, *Statistics, *Wastewater treatment, Data interpretation, Mathematical models, Wastewater management.

A dynamic model for wastewater treatment is composed of a set of equations relating state variables, which may include temperature, pH, and the concentrations of feed and effluent components in the wastewater, and input variables, which include feedrate, addition rate of a base used to control pH, or the flow of steam to a heat exchanger used to maintain a constant temperature. The treatment process is also affected by unmeasured stochastic disturbances and some complex mechanisms that do not appear in the mechanistic models used to describe the treatment process. The use of an extended Kalman filter for state estimation in biological wastewater treatment processes is a way of incorporating the effects of unmeasured disturbances and unknown mechanisms by introducing additional stochastic state variables to the model. The application of the technique requires an adequate mechanistic dynamic model and the identification and modeling of the major sources of stochastic disturbances in the process. The filter allows the on-line tracking of process variables which are not directly measurable. Use of an extended Kalman filter is demonstrated by a simulated application to a high rate anaerobic wastewater treatment process. Unmeasured stochastic disturbances were incorporated into the model through simple random walk functions. (Tappert-PTT)
W91-00130

EVALUATION OF PHOSPHORUS LOADS FROM ONTARIO MUNICIPAL WASTEWATER TREATMENT PLANTS.
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
D. Chapman, W. Randle, and H. Monteith.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 307-321, November 1989. 6 fig, 4 tab, 11 ref, append.

Descriptors: *Canada, *Lake Erie, *Lake Ontario, *Phosphorus, *Pollution load, *St Lawrence River, *Wastewater facilities, *Wastewater treatment, *Water pollution sources, Chemical treatment, Comparison studies, Eutrophication, Monte Carlo method, Secondary treatment, Wastewater disposal.

As a part of efforts to reduce the rate of eutrophication, effluent phosphorus limits have been placed on municipal treatment plants that discharge into the Great Lakes and the St. Lawrence River. Results are presented from an evaluation of the nature and accuracy of phosphorus loads discharged by Ontario municipal wastewater treatment plants into the Great Lakes. Data were examined for the 96 plants treating flows in excess of 4546 cubic meters per day for the period 1981 to 1985. For the Lake Erie, Lake Ontario/St. Lawrence River and Upper Great Lakes basins, total basin phosphorus loads were classified according to type of wastewater treatment system, the type of chemical added for phosphorus removal, plant capacity, and sampling frequency. Load estimation techniques were compared using the 1985 daily data from three representative treatment plants. Annual phosphorus loads were compared using the complete data records for the plants and using Monte Carlo techniques to simulate an incomplete data record typical of once per week effluent phosphorus sampling. Potential sources of bias were identified in annual phosphorus load estimates from municipal treatment plants, including inaccurate flow measurement, inconsistent practices concerning data round-off, and plant bypass during storms or spring snowmelt. The data indicate that a comparatively small number of large plants in each basin accounted for the majority of the annual load discharged and that 16% of the Lake Ontario phosphorus load and 43% of the Upper Great Lakes phosphorus load originated from plants which did not add any chemical to remove phosphorus. (Tappert-PTT)
W91-00132

DESIGN OF DETENTION BASINS FOR INDUSTRIAL SITES.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
D. D. Meredith, A. C. Middleton, and J. R. Smith.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 586-591, July/August 1990. 3 fig, 16 ref, append.

Descriptors: *Detention reservoirs, *Runoff forecasting, *Storm wastewater, *Storm water, *Surface runoff, *Wastewater collection, Design criteria, Hydraulic engineering, Industrial plants, Optimization, Overflow, Regulations, Storm runoff, Water pollution prevention.

Regulations require management of runoff from industrial plant sites so as not to discharge toxic or hazardous pollutants to receiving waters. The purpose of the detention basin is to store the stormwater during periods of runoff and release it at a lower rate to the treatment process. A procedure that uses all of the available rainfall records for a site has been developed for sizing detention basins for stormwater runoff where all of the runoff must be treated. The procedure is simple and results in a design related to overflow rather than inflow recurrence intervals. The use of treatment duration and storage duration curves allows the designer to study the tradeoffs between the design variables to obtain a more nearly optimal solution. The procedure has been used successfully to design several detention basins for industrial plant sites in the United States. (Fish-PTT)
W91-00188

ADSORPTION REMOVAL OF CRESOL BY GRANULAR ACTIVATED CARBON FOR MEDICAL WASTE WATER TREATMENT.
Tokushima Univ. (Japan). Dept. of Public Health.
M. Tanada, T. Miyoshi, T. Nakamura, and S. Tanada.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 45, No. 2, p 170-176, August 1990. 1 fig, 4 tab, 14 ref.

Descriptors: *Activated carbon, *Cresol, *Granular activated carbon, *Hospitals, *Medical wastes, *Phenols, *Pretreatment of wastewater, *Waste treatment, *Wastewater treatment, Adsorption, Hydrogen ion concentration, Mathematical equations, Municipal wastewater.

Waste water from medical facilities contain large quantities of disinfectants which hinder the purification abilities of aerobic bacteria and thus prevent the use of the activated sludge method for medical waste water treatment. Because solid adsorbents such as activated carbon have been used for removing organic substances from wastewater, an investigation was made of the characteristics of adsorption removal of cresol, one of the disinfectants, onto granular activated carbon for medical wastewater treatment. The adsorption isotherms of cresol onto activated carbon at 25 degrees were of the Freundlich type. In order to elucidate which adsorbent properties most affected the amount of cresol adsorbed, the correlation coefficients between the amount adsorbed and physicochemical properties of the activated carbon were calculated. It was concluded that the amount of cresol adsorbed in low equilibrium concentrations was primarily affected by the surface pH of the activated carbon. (Hoskin-PTT)
W91-00203

STATE SPACE APPROACH TO THE BEHAVIOR OF SEWER SYSTEMS.
Barcelona City Dept. of Public Works (Spain). Planning Div.
R. Vazquez Garcia.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 301-312, 1987. 4 fig, 9 ref.

Descriptors: *Hydraulics, *Mathematical models, *Model studies, *Sewer systems, *Stochastic hydrology, Hydraulic models, Mathematical analysis, Mathematical equations, Stochastic models, Weirs.

A state space approach may be a useful tool to develop didactic procedures, build up automatic control systems and draw simple simulation models related to flow routing through storm sewer systems. Systems engineering provides a lot of examples in civil engineering in which the general methodology of the state space approach fits quite well to the mathematical abstraction of the physical reality. By means of state space-based equations, the evolution in a discrete form of debts in different nodes of a sewer system can be followed. A simple model called CSMUSK was developed with the aim of developing a fast way to model weir overflow behavior. (Hoskin-PTT)
W91-00375

HERCULEAN LABORS TO CLEAN WASTEWATER.
Golob's Oil Pollution Bulletin, Cambridge, MA.
T. M. Hawley.
Oceanus OCEAAK, Vol. 33, No. 2, p 72-75, Summer 1990. 1 fig, 1 tab.

Descriptors: *Advanced wastewater treatment, *Nutrient removal, *Wastewater treatment, Biological wastewater treatment, Nitrogen removal, Phosphorus removal, Physiochemical treatment, Primary wastewater treatment, Secondary wastewater treatment, Sludge, Wetlands.

Although standard 'primary' and 'secondary' wastewater treatment technologies effectively separate solid wastes from the water that carries them, they produce considerable amounts of sludge in the process, and usually fail to remove many inorganic nutrients. Those nutrients must be removed if the water is not to contribute to algal blooms and eutrophication. Options for sludge disposal are decreasing. Because of this, alternative sewage treatment technologies are under development. These systems usually address either sewage's biological potential more directly than does standard treatment, or technologically lower sludge production. A system called 'advanced primary' treatment adds synthetic polymers and ferric chloride to wastewater early in the treatment process, which cause suspended solids in primary settling tanks to coagulate and sink. In advanced primary treatment, biological oxygen demand removal and sludge production is about midway between primary and secondary treatment, and suspended solids removal is about equal to secondary treatment. Another alternative treatment system is the use of reclaimed and natural wetlands to 'polish' the effluent prior to its discharge into the general water system. An example is the Orlando Easterly Wetlands Reclamation Project, where effluent already clean to secondary standards flows through the reclaimed wetlands prior to its discharge into the St. Johns River. In 1989, this system removed 80-90% of the total nitrogen and phosphorus from the water flowing through it. Artificial wetlands

are in use for cleaning wastewater even in areas with short growing seasons, such as New England. One system, called 'System Aquatics' treats either raw sewage or septage by passing it through a greenhouse where a series of 5000 liter clear plastic silos are home to engineered ecosystems that convert the organic nutrients into biomass. In Providence, Rhode Island, a Solar Aquatics system treats nearly 60,000 liters a day of domestic sewage laced with heavy metals. Although these various innovative technologies are promising, some large U.S. cities have a long way to go before achieving environmentally friendly sewage treatment and sludge disposal. Every avenue, such as source reduction by on-site composting, should be explored. (Hoskin-PTT)
W91-00387

INVESTIGATING SEPTIC DISPOSAL SITES USING A VELOCITY PERMEAMETER.
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
K. J. Rose, and G. E. Merva.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 5, p 533-552, July 1990. 5 fig, 1 tab, 26 ref.

Descriptors: *Hydraulic conductivity, *Measuring instruments, *Permeameters, *Septic tanks, *Site selection, *Soil properties, *Wastewater treatment, Field tests, Michigan, On-site tests, Statistical analysis.

In the state of Michigan there is no field test to determine the acceptability of a site for a septic disposal system other than the decision of the sanitarian in whose jurisdiction the system is to be installed. The use of a new instrument for determining saturated hydraulic conductivity, the velocity permeameter, was investigated. The velocity permeameter method is based on Darcy's Law, and uses a sample cup to enclose a small volume of soil through which water is forced under some pressure. Field testing was done in conjunction with site evaluations of potential septic system sites by sanitarians in the counties surrounding Lansing, Michigan. Excellent agreement between the velocity permeameter method and the standard method for determination of hydraulic conductivity (constant head method) was found in field/laboratory testing for hydraulic conductivity in the 0.0001-0.76 m/h range. The minimum acceptable value for hydraulic conductivity selected for a septic disposal system site was 0.025 m/h. All 13 sites that were rejected by the sanitarians were also rejected by the velocity permeameter test. The velocity permeameter is a useful tool for evaluating septic disposal sites with borderline soil hydraulic conductivities. (MacKeen-PTT)
W91-00394

GAS-PHASE AND ACTIVATED CARBON MEDIATED THERMAL HYDROGENOLYSIS OF HALOGENATED ORGANICS.
Leiden Rijksuniversiteit (Netherlands). Gorlaeus Labs.
R. Louw, and P. Mulder.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 5, p 555-569, July 1990. 2 fig, 3 tab, 20 ref.

Descriptors: *Cleanup operations, *Halogenated hydrocarbons, *Hazardous wastes, *Industrial wastes, *Waste treatment, Activated carbon, Chemical treatment, Economic aspects, Gas phase, Thermal hydrogenolysis.

Thermal hydrogenolysis may be considered as an alternative to the combustion of halogenated (i.e. chlorinated, fluorinated, and brominated) hazardous wastes. The desired reactions proceed well at temperatures below 1000 C and yield mixtures of light hydrocarbons and some soot. The halogens are converted into HX (with X= Cl, F, or Br). In the presence of excess hydrogen, virtually no chlorine, fluorine, or bromine gases or dioxins are formed. Since carbon monoxide, carbon dioxide, and water do not interfere with hydrogenolysis, syngas, made from coal or oil gasification, is an attractive hydrogen source. A promising process has been designed on this basis which may treat highly halogenated wastes economically. Activated carbon catalyzes the desired dehalogenating reactions and, for many halogenated organics, essentially complete conversion to HX occurs at temperatures less than or equal to 600 C. This alternative seems especially attractive for waste cleanup operations. (Author's abstract)
W91-00395

BASIC GUIDELINES FOR SPECIFYING THE DESIGN OF ULTRAVIOLET DISINFECTION SYSTEMS.
Stottler, Stagg and Associates, Inc., Cape Canaveral, FL.
M. V. Thampi.
Pollution Engineering PLENBW, Vol. 22, No. 5, p 65-69, May 1990. 2 fig, 15 ref.

Descriptors: *Disinfection, *Ultraviolet radiation, *Wastewater reactors, *Wastewater treatment, Design criteria, Dose, Hydraulic properties, Microorganisms, Secondary wastewater treatment, Sewage bacteria, Suspended solids.

Ultraviolet (UV) light disinfection is being increasingly used at wastewater treatment plants in the United States. Characteristics important in the design of UV disinfection systems include lamp type, dose intensity, hydraulic performance characteristics, and monitoring germicidal efficiency. The UV lamp is filled with low pressure mercury vapor and argon and has an available germicidal output of 20-25% of the lamp rating and an expected lifetime of 7,000 to 10,000 hours. High suspended solids shield microorganisms from UV rays. An effluent absorbance of 0.2/cm or less is recommended. For organisms found in secondary wastewater effluent prior to disinfection, 16,000 microW-sec/sq cm is sufficient for inactivation. The desired flow condition in UV reactors is plug flow with minimal longitudinal dispersion. The salt tracer conductivity residence time distribution curve can be used to determine hydraulic performance parameters in UV and other reactors. Coliform assays, viral assays and DNA fluorimetry are used to indicate germicidal inactivation. UV irradiation for disinfection is a viable alternative, and when used with peroxide and ozone, it catalyzes the degradation of toxic organics. (MacKeen-PTT)
W91-00401

SPECIFER'S GUIDE TO POLYMER FEED SYSTEMS.
G. R. Mace.
Pollution Engineering PLENBW, Vol. 22, No. 5, p 75-79, May 1990. 2 fig, 2 tab.

Descriptors: *Polymers, *Suspended solids, *Wastewater treatment, *Water treatment, Design criteria, Equipment, Flocculation, Sludge treatment, Wastewater treatment facilities, Water treatment facilities.

The use of polymers to coagulate and separate suspended solids in water and wastewater and the features of commercially available equipment to mix and dilute polymers are discussed. Four basic types of concentrated polymer are commercially available: dry, emulsion, liquid solution and mannich. Jar tests must be conducted to quantify the performance of the different polymer types for a given water, wastewater or sludge. The four general applications for polymers in increasing order of volume are granular media filtration or polishing, dissolved air flotation/thickening, clarification, and sludge dewatering. The most important step in polymer preparation is the initial introduction of the concentrated polymer into the dilution medium. Additional steps are mixing, aging, metering pump and final dilution. The cost of polymer equipment varies widely and is directly related to the degree of automation. Other factors which should be considered in the design of a polymer system include size of system, bulk storage, type of polymer, operator preferences, system end use, location of polymer addition, frequency of use, ease of operation versus degree of polymer activation obtained, first costs, space and location, and prepackaging. (MacKeen-PTT)
W91-00402

ALTERNATE TECHNOLOGIES FOR WASTEWATER TREATMENT.
J. Hauck, and S. Masoomian.
Pollution Engineering PLENBW, Vol. 22, No. 5, p 81-84, May 1990. 3 fig, 1 tab.

Descriptors: *Advanced wastewater treatment, *Chemical treatment, *Physicochemical treatment, *Wastewater treatment, Aeration, Clarification, Electrodialysis, Ion exchange, Membrane processes, Ozonation, Reverse osmosis, Sequencing batch reactors, Ultrafiltration, Water treatment.

A summary of alternative wastewater treatment technologies is presented. The technologies were designed to complement existing treatment facilities. Ultrafiltration (UF) uses a hollow fiber or spiral wound element to remove organics from water at relatively low feed pressures. UF applications include preparation of water for use in high technology industries, recovery of mixed solvents and treatment of pulp and paper industry wastewater. Reverse osmosis also uses spiral or hollow fiber membranes; however its function is to remove dissolved salts from wastewaters. Electrodialysis uses a series of membranes to separate and concentrate ions, such as concentration of chrome in cooling towers, and in treatment of brackish water and colloids in fresh water. Fine bubble aeration results in a significant reduction in horsepower in the provision of air to the waste treatment system. Sequencing batch reactors are self-contained treatment systems incorporating equalization, aeration and clarification. They have been used to treat wastewater from two hazardous waste sites. Parallel plate clarification enhances particle removal from a flow stream. Insoluble starch xanthate was developed by the U.S. Department of Agriculture to remove trace quantities of heavy metals from plating wastewater. Arsenate and arsenic can be removed by sorption in polymer-chelated ferric ion in a ligand exchanger. Ozonation can be used to disinfect drinking water by killing both bacteria and viruses, and to oxidize organics. (MacKeen-PTT)
W91-00403

BIOLOGICAL TREATMENT OF HAZARDOUS WASTES, SLUDGES AND WASTEWATER.
New Jersey Inst. of Tech., Newark.
P. N. Cheremisinoff.
Pollution Engineering PLENBW, Vol. 22, No. 5, p 87-94, May 1990. 3 fig, 1 tab.

Descriptors: *Biological wastewater treatment, *Hazardous wastes, *Sludge treatment, *Waste treatment, *Wastewater treatment, Activated sludge process, Aerated lagoons, Aerobic conditions, Anaerobic conditions, Bacteria, Denitrification, In situ treatment, Nitrification, Roughing filters, Trickling filters.

A summary of the biological treatment of hazardous wastes, sludges and wastewater is presented. Biological treatment is typically applied to aqueous streams with organic contaminants. Classified according to nature of biological growth, biological process reactors are either suspended growth reactors or attached growth (fixed film) reactors. Fluidized bed reactors represent highly efficient fixed film reactors in which biomass build-up occurs on an inert or active fluidized support media high in external surface area. The principle suspended growth biological treatment processes are: the activated sludge process, the suspended growth nitrification process, aerated lagoons, the aerobic digestion process and high rate oxidation ponds. Aerobic attached growth biological treatment processes are usually used to remove organic matter found in wastewater, or to achieve nitrification. They include trickling filters, roughing filters, rotating biological contactors and fixed bed nitrification reactors. Anoxic denitrification can be accomplished by suspended or attached growth processes. Anaerobic treatment processes include the anaerobic digestion process, anaerobic contact process, and the attached growth anaerobic filter process. Combined anaerobic/anoxic and aerobic processes include facultative stabilization and tertiary maturation ponds. Liquid/solids treatment systems rely on efficient mass transfer controlled by adequate

mixing and aeration. In situ treatment, co-metabolism and denitrification are areas of developing technologies in the biological treatment of hazardous wastes. (MacKeen-PTT)
W91-00404

IMPROVED PERFORMANCE OF UPFLOW ANAEROBIC SLUDGE BLANKET (UASB) REACTORS BY OPERATING ALTERNATIVES.
Korea Advanced Inst. of Science and Technology, Seoul (Republic of Korea). Dept. of Civil Engineering.
H. S. Shin, and B. C. Paik.
Biotechnology Letters BILED3, Vol. 12, No. 6, p 469-474, June 1990. 5 fig, 8 ref.

Descriptors: *Anaerobic digestion, *Biological wastewater treatment, *Operating policies, *Sludge, *Wastewater facilities, *Wastewater treatment, Advanced wastewater treatment, Biogas, Chemical oxygen demand, Effluents, Lipids, Load distribution, Methane, Performance evaluation, Proteins.

The advanced anaerobic process upflow anaerobic sludge blanket (UASB) has been shown to produce high quality effluent and significant cost savings in treating soluble low, medium and complex high strength wastewaters. The successful performance of the UASB process was absolutely dependent on sludge granulation to obtain good settleability and high methanogenic activity of sludge. However, the serious foaming problem and precipitation of proteins in the reactor when overloaded were inhibitory to the release of biogas entrapped in the sludge, which accelerated flotation of the sludge. The efficient operation of UASB reactors treating complex soluble wastewater containing high protein and lipid content was attempted by mixing the reactor content in different modes: a control, a reactor with effluent recirculation, and a reactor mixed with a type of paddle impeller. Higher superficial flow rate increased chemical oxygen demand removal efficiency, sludge retainment, and methane content in biogas not only in the start-up period but also at high volumetric loading rates. However, formation of sludge particles in larger size was hindered by increased upflow liquid velocity. It was concluded that cautious operation is required for an effective UASB reactor as characteristics suitable for granulation of methanogenic sludge are limited and optimal operational protocol for each specific waste is not well established. Results show that the effluent recycle method is one of the proper operational strategies for the successful performance of a UASB reactor treating complex wastewaters containing high concentrations of proteins and lipids. (Agostine-PTT)
W91-00416

SUPERFUND RECORD OF DECISION: INDEPENDENT NAIL, SC.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-00446

DESTRUCTION OF HAZARDOUS CHEMICAL WASTE BY OXIDATION IN SUPERCRITICAL WATER.
Los Alamos National Lab., NM.
C. K. Rofer, and G. E. Streit.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89-012595. Price codes: A03 in paper copy, A01 in microfiche. June 1989. 24p, 3 tab, 10 ref, append.

Descriptors: *Chemical reactions, *Hazardous wastes, *Oxidation, *Wastewater oxidation, *Wastewater treatment, *Water temperature, Chemical wastes, Free radicals, High pressure, Kinetics, Model studies.

The chemistry of oxidation in supercritical water is being investigated for development into a practical destruction process for hazardous chemical waste. In principle, a wide variety of waste streams might be treated by this technology, including those that are unsuitable for incineration because of high water content. To establish a basis for extrapolation of kinetic measurements to a variety of compounds, a mechanism is being developed for oxidation in supercritical water on the basis of conventional free-radical reactions, with modifications for high pressures and high concentrations of water. Global rate expressions for oxidation of methane and methanol in supercritical water have been determined. A base mechanism and modifications to the mechanism to account for the roles of hydrogen bonding and water dimer formation have been investigated for CO. On this limited basis, reasonable agreement between model and experimental results has been obtained. Further, verification of the model with experimental results will provide insight into the roles of hydrogen bonding and water dimer formation in oxidation in supercritical water. (Author's abstract)
W91-00450

WATER CHLORINATION: CHEMISTRY, ENVIRONMENTAL IMPACT AND HEALTH EFFECTS. VOLUME 6.
For primary bibliographic entry see Field 5F.
W91-00476

FORMATION AND PROPERTIES OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE, A POTENT MUTAGEN IN CHLORINATED WATERS.
Abo Akademi, Turku (Finland). Lab. of Forest Products Chemistry.
For primary bibliographic entry see Field 5B.
W91-00486

IDENTIFICATION OF THE STRONG MUTAGEN 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE AND ITS GEOMETRIC ISOMER E-2-CHLORO-3-(DICHLOROMETHYL)-4-OXOBUTENOIC ACID IN MUTAGENIC FRACTIONS OF CHLORINE-TREATED HUMIC WATER AND IN DRINKING WATERS.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5F.
W91-00487

FIELD EVALUATION OF THE EFFECT OF CHLORINATED TREATED SEWAGE ON SETTLEMENT OF OYSTERS (CRASSOSTREA VIRGINICA GMELIN) AND BARNACLES (BALANUS SP).
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5C.
W91-00511

POTENTIAL FOR ADAPTATION OF THE ESTUARINE COPEPOD EURYTEMORA AFFINIS TO CHLORINE-PRODUCED OXIDANT RESIDUALS, HIGH TEMPERATURE, AND LOW OXYGEN.
Maryland Univ. Baltimore County, Catonsville. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W91-00512

TOXICITY AND FATE OF TOTAL RESIDUAL CHLORINE IN OUTDOOR EXPERIMENTAL STREAMS.
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
For primary bibliographic entry see Field 5C.
W91-00513

ACUTE TOXICITY, SUBLETHAL EFFECTS, AND BIOCONCENTRATION OF CHLORINATION PRODUCTS, VIRUSES, AND BACTERIA IN EDIBLE SHELLFISH: A REVIEW.
South Carolina Univ., Columbia. School of Public Health.
For primary bibliographic entry see Field 5C.
W91-00515

METHOD FOR DETERMINING THE COMPLETENESS OF DECHLORINATION WITH SULFITE.
Maryland Univ., College Park. Dept. of Chemistry.
A. C. Nweke, and G. R. Helz.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 741-750, 6 fig, 20 ref.

Descriptors: *Chlorination, *Dechlorination, *Disinfection, *Sulfites, *Wastewater treatment, *Water pollution control, *Water quality control, Chemical analysis, Chlorine, Monitoring, Pollutant identification.

Concern about the toxicity to aquatic organisms of chlorinated discharges has produced pressure on operators of wastewater treatment plants to reduce residual chlorine in effluents. Many operators feel that they can not meet disinfection standards if they significantly reduce the amount of chlorine they apply. Therefore, they are turning increasingly to dechlorination, which permits them to remove residual chlorine after disinfection is completed. Although dechlorination can be accomplished in several ways, application of S(IV) compounds (i.e., sulfur dioxide gas or sulfite salts) is by far the most common approach. A focus on analytical development efforts on the use of formaldehyde to inactivate excess S(IV) through formation of hydroxymethanesulfonate is presented. A neutral pH and 350 mM formaldehyde will quantitatively bind S(IV) species in 1 min or less. At this concentration and pH, formaldehyde does not react appreciably with three test organic chloramines. If the pH of the solution is reduced to 4 after the S(IV) is bound, then iodine will be stable long enough for determination by standard titrimetric procedures. Quantitative recovery of N-chlorotrialanine in a standard solution is possible using formaldehyde to block interference from S(IV) species, when the latter are present, at concentrations commonly found in dechlorinated effluents. Complete analysis of a sample takes approximately 3-4 minutes. Sample manipulation is minimal. (See also W91-00476) (Lantz-PTT)
W91-00532

IDENTIFICATION OF ORGANIC N-CHLORAMINES IN WASTEWATER.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5A.
W91-00533

MODELING THE IMPACT OF NITROGENOUS COMPOUNDS ON WASTEWATER DISINFECTION.
Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
R. A. Isaac, and J. C. Morris.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 917-930, 9 fig, 2 tab, 14 ref.

Descriptors: *Disinfection, *Model studies, *Nitrogen compounds, *Wastewater treatment, Bacteria, Chemical reactions, Chlorination, Chlorine, Mathematical models.

Quantitative insight into the impact that organic chloramines can have on the disinfection of secondary (non-nitrified) wastewater effluent is provided. The chemical species known to be important to disinfection are tracked by a simple kinetic model, and the concentrations of the various disinfectants are expressed as equivalents of HOCl. The equivalences are based on disinfection and not on chemical relationships. Bacterial survival versus exposure based on total residual chlorine (TRC) as the measure of disinfectant is compared to the survival of bacteria when the impacts of the individual disinfectants are taken into account. This

approach improves agreement with the simple disinfection model. Several conclusions can be drawn as a result of this study: (1) the relationship between exposure values in complex systems and bacterial reduction can be improved by taking into account the relative disinfection capabilities of the various chemical species; (2) mathematical models allow for the complex reactions to be tracked and resulting exposure values to be calculated; and (3) experimental confirmation is extremely limited, and appropriately designed investigations are needed to fully evaluate the approach suggested. (See also W91-00476) (Lantz-PTT)
W91-00546

NEW HALAMINE WATER DISINFECTANTS.
Auburn Univ., AL. Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W91-00547

INACTIVATION OF ENTERIC VIRUSES IN CHLORINATED WASTEWATER SPRAYED ON VEGETABLES.
Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
Y. I. Lasowski, and Y. Kott.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 945-953, 5 tab, 15 ref.

Descriptors: *Chlorination, *Disinfection, *Viruses, *Wastewater irrigation, *Wastewater treatment, Chlorine, Fruit crops, Kohlrabi, Lettuce, Onions, Parsley, Tomatoes, Vegetable crops.

Enteric viruses can be isolated from wastewater and are shown to be noxious and resistant to chlorination, compared with pathogenic bacteria. The combination of natural die-off and survival of enteric viruses, after chlorination, on vegetables and fruits has seldom been investigated. The aim of this study was to follow the die-off of enteric viruses in chlorinated wastewater sprayed on vegetables and to find out whether chlorine and solar radiation are factors affecting virus inactivation. In this study, poliovirus LSC 1, coxsackievirus A9, coxsackievirus B5, and echovirus 6 were introduced to secondary wastewater, which was then chlorinated and sprayed on parsley, lettuce, onion leaves, kohlrabi, and tomato. The vegetables, which are kept outdoors, were free of viable viruses within a few days; the same results were obtained when a grape vine was irrigated. The application of chlorine to the wastewater apparently enhanced the inactivation of the viruses. Results illustrated that although natural conditions such as solar activity, humidity, and temperature had an inactivation effect, the activation of chlorine probably stimulated the overall inactivation process. These results should encourage further research in the use of chlorine or other disinfectants to ensure the safety of vegetables and fruits irrigated with secondary wastewater. (See also W91-00476) (Lantz-PTT)
W91-00548

USE OF CHLORINE DIOXIDE IN DISINFECTION OF WASTEWATER.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
N. Narkis, R. Offer, E. Linenberg, and N. Betzer.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 955-966, 8 tab, 11 ref.

Descriptors: *Chlorine dioxide, *Disinfection, *Wastewater treatment, Chlorination, Chlorine, Secondary wastewater treatment.

The feasibility of using ClO2 as an alternative to chlorine in the disinfection of effluents and wastewaters, is examined in this study. Use of ClO2 could help ensure environmentally acceptable finished water suitable for various reuses. The behavior of chlorine dioxide has been investigated in sewage treatment plant effluents and compared to its behavior in organic-free media, such as distilled and tap water. The aim of this research was to investigate whether secondary effects of chlorine dioxide application to effluents exist and if these affect its effectiveness as a disinfectant. Particular attention was paid to the interaction of ClO2 with the inorganic and organic components of effluents and their effects on chlorine dioxide residuals. High efficiency of ClO2 in effluent disinfection is shown. ClO2-treated water was of high bacteriological quality. Efficient disinfection of the effluents is achieved with relatively low ClO2 doses and short contact times in the neutral and acidic pH ranges. Preliminary results regarding the potential of ClO2 as an efficient disinfectant in sewage treatment plant effluents, as compared to Cl2, necessitate additional work, for a comprehensive understanding of disinfection processes of ClO2 in effluent systems. Improved analytical methods are required to overcome complications associated with the determination of ClO2, chlorine, and the accompanying oxygenated chlorine compounds. Dealing with sewage treatment plant effluents further complicates analytical procedures and interpretation of the system's behavior. (See also W91-00476) (Lantz-PTT)
W91-00549

COMBINED SEWER OVERFLOW: A MANAGEMENT STUDY.
Environmental Protection Agency, Washington, DC. Office of Marine and Estuarine Protection.
A. Reilly.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-190151. Price codes: A03 in paper copy, A01 in microfiche. EPA Report No. 600/9-89/010, 1988. 27p, 2 fig, 29 ref.

Descriptors: *Combined sewer overflows, *Management planning, *Urban runoff, *Urbanization, *Wastewater management, Combined sewers, Sewers, Storm wastewater, Wastewater disposal.

In many of the older cities of the United States, the capacity of the combined sewer is exceeded on a daily basis due to both wet weather storm surges and increased volumes of waste generated by new development. As a result, billions of gallons of untreated sewage are discharged on an annual basis into the nations marine bays and estuaries in episodes called 'combined sewer overflow'. There are two primary reasons for the increasing frequency and severity of overflow episodes: (1) the population of cities in coastal areas are growing at rates that far exceed the ability of the sewer infrastructure to accommodate them; and (2) the built-in efficiencies of the original design and of the combined sewer are being exploited by many municipalities to compensate for the increased volumes of sewage associated with the population growth. Since each combined sewer, the area that it drains, and the receiving water into which it discharges, constitutes a unique system, a management strategy should be site specific. This document proposes a framework within which a site-specific and cost-effective management strategy may be formulated. Emphasis is placed on providing tools and methods rather than explicit solutions. (Lantz-PTT)
W91-00568

STAINLESS STEEL IN WASTEWATER TREATMENT PLANTS.
Tuthill Associates, Blacksburg, VA.
A. H. Tuthill.
Water Engineering and Management WENMD2, Vol. 137, No. 7, p 31-33,64, July 1990. 3 fig, 1 tab, 4 ref.

Descriptors: *Construction materials, *Corrosion control, *Pipes, *Steel, *Wastewater facilities, Design standards, Hydraulic equipment, Underground structures, Underwater.

To obtain the best results from the stainless steel selected for wastewater treatment plants, the suitability and performance of several grades of stainless steels must be recognized. Stainless steel equipment is exposed to several different environments including the local atmospheric environment, different process environments, and underground conditions in buried piping and tanks. Type 304, 304L, 316 and 316L are austenitic stainless steels which have about 18% chromium (for corrosion resistance) and also contain 8% nickel. The low carbon grade 304L produced to the A778 specification is fully suitable for wastewater treatment plant service except in those few geographic locations where chlorides in the local water exceed 200 ppm. For these locations type 316L would be preferred, since stainless steels are subject to localized corrosion in tight stationary crevices in aqueous environments when chlorides are present. Since ASTM specifications do not cover shop fabrication of piping, each shop must develop its own specifications for butt welding and fabrication of piping to the pipe drawings. The practice of full immersion pickling after welding is helpful in reducing surface contamination that might otherwise lead to rust streaking and pitting and in improving resistance to microbiological influenced corrosion. (VerNooy-PTT)
W91-00628

GROWTH OF BIOPELLETS ON GLUCOSE IN UPFLOW ANAEROBIC SLUDGE BED (UASB) SYSTEMS.
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
P. A. L. N. S. Sam-Soon, R. E. Lowenthal, M. C. Wentzel, and G. R. Marais.
Water SA WASADV, Vol. 16, No. 3, p 151-164, July 1990. 3 fig, 3 tab, 10 ref, 3 append.

Descriptors: *Anaerobic digestion, *Biopellets, *Butyrates, *Glucose, *Sludge bed, *Wastewater treatment, Biodegradation, Chemical oxygen demand, Fermentation, Hydrogen, Substrates, Volatile solids.

An investigation was made into the response of an upflow anaerobic sludge bed (UASB) system using a defined substrate, glucose. Glucose was selected because its biochemical fermentation pathways are well known and this allowed process identification from product formation. It also eliminated the presence of a polymer in the influent as a possible cause for pellet formation. Excellent pellet formation was observed in the single UASB reactor system. The single reactor was separated into 2 in-series reactors with the first operating in the high hydrogen partial pressure (high pH2) phase. In the high pH2 reactor it was found that: (1) butyrate was generated at a sludge age less than about 2 days; when the sludge age exceeded about 2 to 3 days, no butyrate was observed, apparently because butyrate oxidizers became established; (2) soluble chemical oxygen demand (COD) removal was about 21% on average; (3) the overall volatile solids (pellet solids plus suspended solids) yield was 0.47 mg volatile suspended solids (VSS)/mg COD removed; (4) from a glucose balance the hydrogen flux was estimated and the gross yield of the hydrogenotrophs (organism plus polymer) calculated, 0.23 mg VSS/mg COD(H2). This is about 6 times greater than the reported values for hydrogenotrophs (0.043 mg VSS/mg COD(H2)) and is due to polymer formation. (See also W91-00632 and W91-00633) (Author's abstract)
W91-00631

EFFECT OF NITROGEN LIMITATION ON PELLETISATION IN UPFLOW ANAEROBIC SLUDGE BED SYSTEMS.
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
P. A. L. N. S. Sam-Soon, R. E. Lowenthal, M. C. Wentzel, and G. R. Marais.
Water SA WASADV, Vol. 16, No. 3, p 165-170, July 1990. 2 tab, 1 fig, 2 ref.

Descriptors: *Anaerobic digestion, *Biopellets, *Chemical oxygen demand, *Glucose, *Nitrogen, *Sludge bed, *Wastewater treatment, Biodegradation, Fermentation, Hydrogen, Limiting nutrients, Substrates, Volatile solids.

An upflow anaerobic sludge bed (UASB) reactor was set up to operate in the high hydrogen partial pressure phase at 30 C. In this UASB system treating the carbohydrate substrate glucose, in order to obtain unimpeded pellet formation, the influent TKN/COD must be greater than that required for cell synthesis and amino acid/polypeptide formation, estimated at about 0.02 mg nitrogen/mg influent chemical oxygen demand (COD). As the influent TKN/COD decreases below this level; (1) growth of the pellet forming hydrogenotroph Methanobacterium Strain AZ is increasingly inhibited, (2) associated pellet formation decreases and (3) an increasingly high excess hydrogen partial pressure develops, giving rise to hydrogen loss from the system as a gas. Hydrogen escaping can account for a loss of up to 14% of the influent COD. If the influent TKN/COD falls below that required for cell synthesis, estimated at about 0.0086 mg nitrogen/mg influent COD, acidogen synthesis is inhibited and their specific yield is reduced. (See also W91-00631 and W91-00633) (Author's abstract)
W91-00632

PELLETISATION IN A UASB SYSTEM WITH PROTEIN (CASEIN) AS SUBSTRATE.
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
R. E. Moosbrugger, R. E. Lowenthal, and G. R. Marais.
Water SA WASADV, Vol. 16, No. 3, p 171-178, July 1990. 5 fig, 2 tab, 11 ref.

Descriptors: *Anaerobic digestion, *Biopellets, *Casein, *Chemical oxygen demand, *Proteins, *Sludge bed, *Wastewater treatment, Biodegradation, Fermentation, Hydrogen, Organic loading, Substrates, Volatile solids.

Biological pellet formation was readily established in a laboratory-scale upflow anaerobic sludge bed (UASB) reactor treating a proteinaceous substrate, casein. Pellets were small (less than 2 mm), fragile and black. To obtain information on bed behavior, the bed was divided and operated as a 2 in-series reactor system, the first reactor operating in a high and the second in a low hydrogen partial pressure state. The first reactor produced (virtually) all the pellets with a sludge yield of 0.26 mg volatile suspended solids (VSS)/mg chemical oxygen demand (COD) removed (COD removal 3500 mg/L for influent COD 10,000 mg/L). However, 2/3 of the VSS generated was lost to the second reactor due to pellet break-up. Deamination generated ammonium in excess of nitrogen requirements for pellet formation, and generated sufficient alkalinity to buffer the minimum pH in the bed to approximately 6.2 without alkalinity supplemented in feed; maximum pH in bed was about 7.6. With influent COD of 10,000 mg/L maximum loading was achieved at 65 kg COD/cu m pelletized bed (without signs of failure), with soluble COD removal 75% of influent COD. (See also W91-00631 and W91-00632) (Author's abstract)
W91-00633

CASE HISTORIES OF SULFIDE CORROSION: PROBLEMS AND TREATMENTS.
Brown and Caldwell, Sacramento, CA.
For primary bibliographic entry see Field 8G.
W91-00768

HYDROGEN SULFIDE TREATMENT SYSTEMS IN SANITARY SEWERS.
HDR Engineering, Inc., Denver, CO.
J. D. Chwirka, and T.T. Satchell.
Water Environment & Technology WAETEJ, Vol. 2, No. 7, p 48-53, July 1990. 2 fig, 1 tab, 5 ref.

Descriptors: *Hydrogen sulfide, *Sewer systems, *Wastewater treatment, *Wastewater treatment facilities, Cost analysis, Gravity sewers, Interceptor sewers, Mathematical studies, Model studies, Odor control, Oxidation, Pumping plants.

The prevention and control of hydrogen sulfide generation is an important aspect of wastewater collection that must be understood by those who design and operate these systems. Hydrogen sulfide generation in sanitary sewer systems may be minimized or prevented by limiting the use of pump stations in the collection system, maintaining proper grades in gravity sewers, and by adding chemicals to the wastewaters to oxidize sulfides. There are, however, many situations where pump stations are a necessity, where sewers must be constructed using flat grades, and where the use of oxidizing chemicals is not cost effective. Where conditions promote the generation of hydrogen sulfide, it may be appropriate to use corrosion-resistant materials in the sewer system and to remove hydrogen sulfide from the foul air by treatment. The decision to use a hydrogen sulfide treatment system in lieu of prevention methods is a matter of economics. Treatment systems may be cost-effective in situations where a large quantity of hydrogen sulfide is generated and the wastewater flow is high, and when hydrogen sulfide is expected to be a problem in large interceptor sewers. The treatment system design should be developed around three elements: effective collection of the foul air, treatment to remove hydrogen sulfide, and discharge of the treated air. Specifics are given for: (1) sewer ventilation design, which includes the prediction of hydrogen sulfide generation by the commonly used Pomeroy-Parkhurst equation; (2) hydrogen sulfide treatment, accomplished by the two processes adsorption and absorption; and (3) discharge of treated air, which includes methods for dispersion of the discharged air. (Agostine-PTT)
W91-00769

COMMERCIAL OXYGEN USE IN WATER-QUALITY MANAGEMENT.
Vanderbilt Univ., Nashville, TN.
R. E. Speece, N. Nirmalakhandan, and G. Tchobanoglous.
Water Environment & Technology WAETEJ, Vol. 2, No. 7, p 54-61, July 1990. 10 fig, 2 tab, 4 ref.

Descriptors: *Aeration, *Commercial oxygen, *Oxygen, *Oxygenation, *Wastewater treatment, *Water quality control, Activated sludge, Aeration tanks, Aerators, Clarifiers, Cost analysis, Dissolved oxygen, Fluidized bed process, Oxygen generation, Rotating biological contactors, Sewers, Water mains.

Commercial oxygen use in water-quality management is in some cases more economical than air as an oxygen source when based on total cost per ton of oxygen dissolved. Two specific issues must be addressed when considering the use of commercial oxygen: the total cost per pound of oxygen dissolved in the water and water quality objectives that cannot be met economically using air, but can be met using commercial oxygen. All potential applications for the use of commercial oxygen require elevated dissolved oxygen (DO) concentrations that make aeration with air progressively expensive and commercial oxygen more attractive. Special design conditions are necessary for oxygen dissolution equipment using commercial oxygen to ensure high absorption. Among the aerators described are a downflow bubble contact aerator, U-tube contactor, countercurrent packed column contactor, and a conventional diffused aerator. Process considerations are given for the following potential uses of commercial oxygen: gravity sewers, force mains, primary clarifiers, activated sludge aeration tanks, rotating biological contactors, and fluidized-bed biological reactors. The oxygen may be generated on-site or liquid oxygen (LOX) may be trucked in and stored. If LOX is stored on-site, a cryogenic storage vessel must be available. The two processes used most commonly to generate high-purity oxygen are pressure-swing adsorption (PSA) for small applications and the cryogenic air-separation process for large applications. It is concluded that with careful attention to design details, the use of oxygen offers significant environmental and economic advantages over the use of oxygen from air. (Agostine-PTT)
W91-00770

SLUDGE MANAGEMENT SYSTEMS
Montgomery (James M.) Consulting Engineers, Inc., Pasadena, CA.
J. M. Montgomery Consulting Engineers.
Water Environment & Technology WAETEJ, Vol. 2, No. 7, p 62-69, July 1990. 7 fig, 4 tab, 25 ref.

Descriptors: *Sludge, *Sludge treatment, *Waste management, *Wastewater treatment, *Wastewater treatment facilities, Effluents, Permits, Secondary wastewater treatment, Sludge thickening, Sludge volume index, Waste disposal.

Reasons for National Pollutant Discharge Elimination System (NPDES) permit limit noncompliance at publicly owned treatment works (POTWs) have been ascertained through the use of comprehensive performance evaluations. Most of these POTWs treated less than 37,850 cu m/d (10 mgd) of wastewater through secondary treatment. Sludge management system limitations were major contributors to noncompliance at about 49% of the plants evaluated and were grouped into three categories: sludge thickening and wasting, stabilization, and ultimate disposal. More than one limitation contributed to effluent quality excursions above permit limits. Several studies revealed that most limitations may be attributed to inaccurately estimated masses or waste sludge volumes, inadequately sized processing equipment to address waste sludge mass or volume variations, and inflexibility in sludge processing operations and sludge management options. Design considerations which should be addressed for each sludge system component are presented. These include: mass production and accumulation considerations, volume and concentration considerations, management system design considerations, and system flexibility. It is concluded that if these elements are not thoroughly addressed by system designers and plant staff, there is bound to be continued facility discharge permit violations induced by identifiable sludge management system limitations. (Agostine-PTT)
W91-00771

MICROTUNNELING TECHNIQUES AID SEWER INSTALLATION.
Houston Dept. of Public Works, TX.
For primary bibliographic entry see Field 8A.
W91-00773

LAGOONS, LEACH FIELDS, AND OTHER ASSISTANTS OF NATURE.
Water Environment & Technology WAETEJ, Vol. 2, No. 8, p 37-41, August 1990. 3 tab, 4 ref.

Descriptors: *Biological wastewater treatment, *Lagoons, *Land treatment, *Leach fields, *Wastewater treatment, Aquatic plants, Permits, Septic tanks, Septic wastewater, Wetlands.

Natural wastewater treatment systems, the oldest recorded form of wastewater treatment can be divided into two categories: soil-based systems (e.g., septic tank leach fields) and aquatic-based systems (e.g., facultative lagoons). Historically, natural systems have been favored by small communities because like most natural systems they are economical and require fewer operations personnel, consume less energy, and produce less sludge than conventional wastewater treatment processes. There are four major types of soil-based systems: slow rate (SR), rapid infiltration (RI), overland flow (OF), and subsurface systems (leach fields or absorption beds). Lagoons, constructed and natural wetlands, and floating plant systems are the primary forms of aquatic systems. Land availability and cost are key factors in deciding whether or not a natural system is appropriate. If sufficient land is available, then cost, effluent-quality objectives, and site characteristics must be evaluated. The ability to discharge wastewater to surface waters must also be considered. While natural systems offer significant advantages, there are potential problems that should be considered before selecting or when working with a natural system. These problems include: unclear objecting; providing adequate operator training; natural systems can take years to reach their optimum performance; and proper construction is critical. (Korn-PTT)
W91-00799

DEVELOPMENT OF A NEW METHODOLOGY FOR THE ASSESSMENT OF SPECIFIC METHANOGENIC ACTIVITY.

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A. James, C. A. L. Chernicharo, and C. M. M. Campos.

Water Research WATRAG, Vol. 24, No. 7, p 813-825, July 1990. 14 fig, 6 tab, 18 ref.

Descriptors: *Methane, *Methanogenesis, *Sludge, *Sludge treatment, *Wastewater treatment, Anaerobic conditions, Anaerobic digestion, Data acquisition, Respirometry, Warburg respirometer.

The measurement of the methanogenic activity of anaerobic sludge is important in order to classify its potential for converting soluble substrate to methane and carbon dioxide. Previously, the measurement of the potential of anaerobic sludges to convert soluble substrate into CH4 and CO2 has mainly been carried out in two different ways: (1) by the so called specific methanogenic activity test (SMA), through the methane production rate; and, (2) by the assessment of the coenzyme F420 contents in the sludge. However, a very poor correlation was found between the measurements of F420 concentrations and the SMA test using acetate as substrate. Therefore, improvements of the SMA test through a methodology that could easily be controlled and standardized would lead to more reliable results. A new methodology using a modified Warburg respirometer has been successfully used for the assessment of specific methanogenic activity. The Warburg respirometer has the ability to test several samples simultaneously which gives increased accuracy through replication. The test can be shortened when it is used to assess the mathanogenic activity, as the methane production rate does not change significantly. However, when the aim of the test is to establish the degree of degradability, it should be run until the rate of gas production drops sharply, because the assessment of degradability is a function of the area under the curve CH4-production versus time. (Korn-PTT)
W91-00805

COMPARISON OF MEDIA TYPES IN ACETATE FED EXPANDED-BED ANAEROBIC REACTORS.

Illinois Univ., Urbana. Dept. of Civil Engineering.
P. Fox, M. T. Suidan, and J. T. Bandy.

Water Research WATRAG, Vol. 24, No. 7, p 827-835, July 1990. 10 fig, 2 tab, 26 ref.

Descriptors: *Anaerobic digestion, *Granular activated carbon, *Methanogenesis, *Wastewater treatment, Acetates, Biofilms, Experimental design, Microorganisms, Shear stress, Sludge.

A synthetic feed, containing acetate as the only carbon source, was used to start-up four different anaerobic expanded-bed reactors containing three different types of microbial attachment media. The media types used were low-density anthracite, granular activated carbon (GAC) and two sizes of sand. All media types were of the same average diameter, 0.7 mm, except for a smaller sand, 0.35 mm. These media types were chosen to compare surface roughness, macroscopic shear stresses due to upflow velocity and sphericity. The 0.7 mm sand required the greatest upflow velocity, 16 cm/s, while the other reactors had upflow velocities of 5.5-6.0 cm/s. Sand had the least surface roughness and GAC had the roughest surface, while anthracite had the most angular shape. At steady-state, the GAC reactor retained 3.75-10 times the attached biomass retained on the other media tested and the GAC reactor accumulated biomass at a faster rate during start-up. Shear losses reflected the biomass accumulation with the two sand and anthracite media having shear loss coefficients 6-20 times greater than that of the GAC medium. Sand induced the formation of sludge granules in both sand reactors with two species of methanogens and stability of the sludge blankets was critical to reactor performance. Scanning electron microscopy demonstrated that attached growth developed in crevices where biomass was protected from shear forces. Attached growth on the sand and anthracite media was located only in crevices, while the GAC medium is completely covered with crevices and biofilm developed on the entire GAC particle. Surface roughness was critical to biofilm development with the rougher surface providing the better attachment medium. (Author's abstract)
W91-00806

PHOTOCHEMICAL DISINFECTION OF EFFLUENTS-PILOT PLANT STUDIES.

Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.
A. Acher, E. Fischer, R. Zellingher, and Y. Manor.

Water Research WATRAG, Vol. 24, No. 7, p 837-843, July 1990. 7 fig, 3 tab, 15 ref. U.S.-Israel Binational Agricultural Research and Development Fund (BARD) US 613-83 and NCRD Israel-DFVLR, Koeln-Porz, Germany WT-8812-581.

Descriptors: *Disinfection, *Solar radiation, *Wastewater treatment, *Wastewater utilization, *Water reclamation, *Water reuse, Dissolved oxygen, Experimental design, India, Methylene blue, Municipal wastewater, Pilot plants, Solar disinfection, Wastewater disposal.

A new method of photochemical disinfection of domestic effluents for crop irrigation was investigated in a pilot plant. It uses sunlight as the energy source, the oxygen dissolved in water (DO) as the oxidizing agent and methylene blue (MB) as an intermediary for the absorption and transfer of the sunlight energy (red range) to activate DO and/or to destabilize the organic matter. The pilot plant consists of a series of six identical reactors, each 488 cm in length and 35 cm in height. The reactors were constructed from welded galvanized steel plates having a trapezoidal cross-section. A height differential of about 10 cm between two adjacent reactors ensured free overflow of the treated effluent through the pilot plant. Hydraulic experiments carried out with different effluent flow rates led to the construction and mounting of hydraulic devices which improved the relative residence time of the effluent in the reactors and decreased the hydraulic short-circuiting of the flowing effluent. The lack of DO in the supplied effluent was overcome by using a new method of adding O2 (from 0.1-0.5 to 4-6 mg/l, by introducing the effluent under pressure. The best microbiological results were obtained in disinfection experiments done under the following conditions: pH, 8.8-8.9 (CaO 80-90 g/cubic m); DO, 4.5-5.5 mg/L, MB, 0.85-0.90 g/ cubic m; effluent flow rate, 10 cubic m/h; effluent depth, 20 cm; average sunlight exposure, 58 min; and sunlight intensities, 700-2000 micro square E/s. The decrease in the microorganism count was (logs): coliforms, 3.0; fecal coliforms, 3.1; enterococci, 3.76; and poliovirus, 1.8. These results were reproducible and could be improved by technical amelioration of the pilot plant. (Author's abstract)
W91-00807

BIODEGRADATION KINETICS OF SUBSTITUTED PHENOLICS: DEMONSTRATIONS OF A PROTOCOL BASED ON ELECTROLYTIC RESPIROMETRY.

Clemson Univ., SC. Dept. of Environmental Systems Engineering.

For primary bibliographic entry see Field 5B.
W91-00809

RESPIRATION INHIBITION KINETIC ANALYSIS.

Clemson Univ., SC. Dept. of Environmental Systems Engineering.
V. T. Volskay, and C. P. Leslie Grady.

Water Research WATRAG, Vol. 24, No. 7, p 863-874, July 1990. 5 fig, 6 tab, 19 ref. EPA Cooperative Agreement CR-813382-01-0.

Descriptors: *Biodegradation, *Butyrates, *Inhibition, *Kinetics, *Respirometry, *Wastewater treatment, Experimental design, Monod term, Oxygen uptake, Substrates.

A protocol was developed for measuring the inhibitory effects of synthetic organic compounds on the biodegradation of naturally occurring (biogenic) organic matter. A tiered approach based on respirometry was employed. In the first tier, compounds were screened to determine if their effects were sufficiently inhibitory to warrant further testing. This was done at an inhibitor concentration of 1000 mg/l, or the solubility limit if lower, and at both high and low biogenic substrate concentrations. If a compound cause more than 50% inhibition in a screening test, the stability of its effect was determined next. Finally, compounds causing stable responses were subjected to the respiration inhibition kinetic analysis in which the Monad kinetic parameters describing the biodegradation of butyric acid were measured in the presence of several inhibitor concentrations by using a technique based on that of Cech, thereby allowing the effects of inhibitor concentration on biodegradation kinetics to be quantified. The respirometric technique of Cech offers a convenient and simple means for determining the impact of xenobiotic organic compounds on the biodegradation of biogenic organic matter. (Author's abstract)
W91-00810

ACTIVITY AND ADAPTATION OF NITRILOTRIACETATE (NTA)-DEGRADING BACTERIA: FIELD AND LABORATORY STUDIES.

Montana State Univ., Bozeman. Dept. of Microbiology.
G. A. McFeters, T. Egli, E. Wilberg, A. Alder, and R. Schneider.

Water Research WATRAG, Vol. 24, No. 7, p 875-881, July 1990. 4 fig, 40 ref.

Descriptors: *Biodegradation, *Fate of pollutants, *Microbial degradation, *Nitrilotriacetic acid, *Sediment contamination, *Wastewater treatment, Adaptation, Experimental design, River sediments, Sand, Suspension, Water pollution.

Adaptation of bacterial activity for the degradation of nitrilotriacetate (NTA) was studied using natural sediment samples and an NTA-degrading bacterium (strain ATCC 29600). Sediment samples from a river with persistent levels of NTA had much higher NTA-degradative activity than comparable samples from a less contaminated control site. When sediment from the control site was exposed to high levels of NTA a 5 day lag preceded an abrupt increase in NTA degradation while strain 29600 colonized on sand and grown in the absence of NTA became induced within eight hours. The induction of strain 29600 was compared between bacteria in suspension and cells attached to sand. The sand-associated bacteria became induced 4 to 5 hours before the planktonic suspension and displayed over threefold greater specific activity. Suspensions of strain 29600 became adapted within 8 hours when placed in membrane diffusion chambers that were immersed within a municipal wastewater reactor containing NTA. These findings support the concept that induction is a part of the process of bacterial adaptation to degrade NTA and sand-associated bacteria can adapt more quickly to and have a greater degradation activity for NTA than planktonic cells. (Author's abstract)
W91-00811

USE OF A GEL-FORMING BIOPOLYMER DIRECTLY DISPENSED INTO A LOOP FLUIDIZED BED REACTOR TO RECOVER DISSOLVED COPPER.

California State Univ., Long Beach. Dept. of Microbiology.
L. K. Jang, G. G. Geesey, S. L. Lopez, S. L. Eastman, and P. L. Wichlacz.

Water Research WATRAG, Vol. 24, No. 7, p 889-897, July 1990. 7 fig, 2 tab, 20 ref, append. NSF Grant CTS-9000897, CBT-8721943, and ECE-8701462.

Descriptors: *Absorption, *Chemical recovery, *Copper, *Fluidized bed process, *Gels, *Waste recovery, *Wastewater treatment, Alginate gel, Chemical interactions, Copper binding, Experimental design, Instrumentation, Wastewater reactors.

A novel technique for the recovery of copper from synthetic aqueous solutions containing 60-200 ppm dissolved copper was developed. A 3.2% by

weight of algin solution is a favorable absorbent for dissolved copper. A viscous solution of sodium alginate (a kelp-derived biopolymer known to bind copper) was dispensed dropwise, using a multi-tip dispenser, into the synthetic solution circulating in an air-lift glass loop fluidized bed reactor. Upon contact with the copper-containing solution, the alginate gelled into stable spheres which continued to circulate in the reactor to absorb copper. When a drop of concentrated sodium alginate solution hits the surface of an aqueous solution containing Cu(2+) at a sufficiently high concentration, a spherical bead is formed as a result of a bridging reaction between Cu(2+) and the uronate residues of the alginate molecules. The percent of copper recovered at the lower ionic strength (0.01 M NaNO3) was found to be greater than that at the higher ionic strength (0.1 M NaNO3) of the solution. Consequently, the conditional copper-binding stability constant for the lower ionic strength solution was greater. An intrinsic copper-binding stability constant, independent of the ionic strength of the solution, was obtained by using a two-phase model modified from the work of Jang. This two-phase model allows the estimation of the activity of free, unbound Cu(2+) in the gel fluid. (Author's abstract)
W91-00813

STUDY OF PHOSPHATASE ACTIVITY IN ANAEROBIC SLUDGE DIGESTION.
Beijing Solar Energy Research Inst. (China).
W. Zhenglan, G. Yue, and L. Lanying.
Water Research WATRAG, Vol. 24, No. 7, p 917-920, July 1990. 2 fig, 1 tab, 6 ref.

Descriptors: *Anaerobic digestion, *Phosphatases, *Wastewater facilities, *Wastewater treatment, Enzymes, Hydrogen ion concentration, Methane, Volatile acids.

The start and operation of large anaerobic digesters are generally carried out in a conservative way because of the unpredictability of imminent failure in the anaerobic digestion process. Phosphatases are enzymes which cleave phosphate groups from their substrates and their activities have a high correlation with the populations of acid-producing bacteria and phosphatase-producing bacteria. The acid and alkaline phosphatase activities at different organic loadings in an anaerobic plug-flow digester and a UASB digester were determined together with volatile acid concentrations, pH values, and methane production. Increases in alkaline and acid phosphatase activity (especially in acid phosphatase) were found in both digesters to be overfed to the level of souring and failure. These increases were observed up to 10 days before the occurrence of more volatile fatty acids production and lower pH values. Phosphatase activity in the digesters appears to be a rapid biochemical test for crediting the instability or failure of anaerobic digestion. (Author's abstract)
W91-00817

EFFECTS OF ANILINES AND HYDANTOINS ON THE METHANOGENIC DEGRADATION OF SELECTED PHENOLS.
Alberta Univ., Edmonton. Dept. of Microbiology.
P. M. Fedorak, W. B. Kindzierski, and S. E. Hrudey.
Water Research WATRAG, Vol. 24, No. 7, p 921-925, July 1990. 4 fig, 29 ref.

Descriptors: *Coal wastes, *Methane, *Phenols, *Wastewater treatment, Anaerobic conditions, Anilines, Degradation, Hydantoins, Inhibition, Methanogenesis, Toluidines.

Wastewaters generated during coal gasification, liquefaction and coking contain a complex mixture of organic and inorganic compounds. Phenols are the major organic contaminate in such wastewaters. Although the concentration of the phenols are frequently high enough to inhibit biological wastewater treatment processes, other unidentified, and presumably nonphenolic organics contribute to the inhibitory nature of these wastewaters. The anaerobic methanogenic process for phenolic removal has met with little success, in the absence of activated carbon, because of these inhibitory compounds. In this study, five anilines and two hydantoins commonly found in coal conversion wastewaters were evaluated in batch culture, serum bottle tests to determine whether they inhibited phenol-degrading, or p-cresol-degrading methanogenic cultures. Working with individual compounds, phenol degradation and subsequent methanogenesis were not affected by 29 mg/L N-methylaniline, 97 mg/L aniline, 300 mg/L o-methylaniline, 300 mg/L m-methylaniline or 300 mg/L p-methylaniline. Neither p-cresol degradation or subsequent methanogenesis was affected by 500 mg/L hydantoin or 500 mg/L 5,5-dimethylhydantoin. Extended incubation periods showed that none of the three isomers of ring substituted methyl anilines and neither of the two hydantoins were readily degraded to methane. (Author's abstract)
W91-00818

EXPERIMENTAL INVESTIGATION OF SIZE DISTRIBUTION OF SUSPENDED PARTICLES IN GRANULAR BED FILTRATION.
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
For primary bibliographic entry see Field 5F.
W91-00819

QUANTITATIVE MICROBIOLOGICAL ANALYSIS OF BACTERIAL COMMUNITY SHIFTS IN A HIGH-RATE ANAEROBIC BIOREACTOR TREATING SULFITE EVAPORATOR CONDENSATE.
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Biotechnologie.
U. Ney, A. J. L. Macario, E. Conway de Macario, A. Aivasidis, and S. M. Schoberth.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2389-2398, August 1990. 3 fig, 4 tab, 52 ref.

Descriptors: *Bacterial analysis, *Biological wastewater treatment, *Wastewater reactors, *Wastewater treatment, Anaerobic bacteria, Biofilms, Fermentation, Methane bacteria, Microbiological studies, Pulp wastes.

The bacterial population of a high-rate, anaerobic, fixed-bed loop reactor treating sulfite evaporator condensate from the pulp industry was studied over a 14-month period. This period was divided into seven cycles that included a startup at the beginning of each cycle. Some 82% of the total biomass was immobilized on and between the porous glass rings filling the reactor. The range of the total number of microorganisms in these biofilms was 2-7 x 10(9) cells/ml. Enumeration and characterization by microbiological methods and by phase-contrast, epifluorescence, and electron microscopy showed that the samples consisted mainly of the following methanogens: a Methanobacterium species a Methanosarcina species a Methanobrevibacter species and a Methanothrix species as well as furfural-degrading sulfate-reducing bacteria resembling Desulfovibrio furfuralis. Viable counts of hydrogenotrophic methanogens were relatively stable (mostly within the range of 320 million to 750 million cells/ml), but Methanobrevibacter cells increased from less than 5 to 30% of the total hydrogenotrophic count after transfer of the fixed bed into a second reactor vessel. Acetotrophic methanogens reached their highest numbers of 130 million to 260 million cells/ml in the last fermentation cycles. They showed a morphological shift from sarcina-like packets in early samples to single coccoid forms in later phases of the fermentation. Furfural-degrading sulfate reducers reached counts of 10 million to 58 million cells/ml. The distribution of the chief metabolic groups between free fluid and biofilms was analyzed in the fifth fermentation cycle: 4.5 times more furfural degraders were found in the free fluid than in the biofilms. In contrast, 5.8 times more acetotrophic and 16.6 times more hydrogenotrophic methanogens were found in the biofilms than in the free liquid. The data concerning time shifts of morphotypes among the trophic groups of methanogens corroborated the trends observed using immunological assays on the same samples. (Author's abstract)
W91-00829

DETECTION AND ANALYSIS OF TWO SEROTYPES OF AMMONIA-OXIDIZING BACTERIA IN SEWAGE PLANTS BY FLOW CYTOMETRY.
ORPEGEN, Medizinisch-Molekularbiologische Forschungsgesellschaft mbH, Heidelberg, Germany.
A. Volsch, W. F. Nader, H. K. Geiss, G. Nebe, and C. Birr.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2430-2435, August 1990. 4 fig, 1 tab, 32 ref. Baden Wurttemberg Grant PA 86.036, German Minister for Research and Technology Grant 02 WA 8940/5.

Descriptors: *Bacterial analysis, *Nitrification, *Wastewater facilities, *Wastewater treatment, Activated sludge, Ammonia removal, Bacteria, Flow cytometry, Heidelberg, West Germany.

Two different serotypes of the genus Nitrosomonas were isolated from samples of the Heidelberg sewage plant Heidelberg. These nitrifers were enumerated in activated sludge of various other sewage plants after immunofluorescent labeling and staining with propidium iodide by flow cytometry. The concentrations of these serotypes of Nitrosomonas spp. were in the range of 0.1 to 2%. A test to determine the activity of ammonia-oxidizing bacteria was also developed. Nitrite-oxidizing bacteria were specifically inhibited with sodium chlorate, and the activity of ammonia-oxidizing bacteria could be calculated from the increase of nitrite. Concentrations and activities of ammonia oxidizers were measured for a period of 6 months in the Heidelberge sewage plant. With one exception, activities and concentrations of ammonia-oxidizing bacteria decreased and increased in parallel. (Author's abstract)
W91-00831

CARBON AND NITROGEN TRANSFORMATIONS IN WASTEWATER DURING TREATMENT WITH HYDROCOTYLE UMBELLATA L.
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
K. K. Moorhead, and K. R. Reddy.
Aquatic Botany AQBODS, Vol. 37, No. 2, p 153-161, July 1990. 6 fig, 3 tab, 16 ref.

Descriptors: *Aquatic plants, *Biological oxygen demand, *Nitrification, *Wastewater treatment, Denitrification, Effluents, Oxygen transfer, Primary wastewater treatment, Secondary wastewater treatment.

The transport of oxygen through aerial plant tissue of aquatic plants into the root zone has important ramifications on C and N transformations in wastewater. Oxygen transport by pennywort (Hydrocotyle umbellata L.) and its effects on biological oxygen demand (BOD) and nitrification were investigated for primary and secondary treated sewage effluent. The treatments included flasks sealed with a rubber stopper to serve as a control, open flasks to determine effects of oxygen diffusion from the atmosphere, flasks with a plant held by a split rubber stopper and open flasks with a plant. The N-15 labeled effluents were analyzed at 0, 1, 2, 4 and 8 days for dissolved oxygen, BOD, total Kjeldahl N (TKN), ammonia nitrogen and nitrate nitrogen. The plants were analyzed for TKN. Pennywort was shown to be very effective in reducing BOD in primary sewage effluent. A 42% reduction of BOD in 4 days was attributed to oxygen transport by pennywort with an additional 30% due to oxygen diffusion from the atmosphere. Nitrification was difficult to document in either sewage effluent although 22-26% of the added N-15 was not accounted for in treatments with plants and was presumably lost through denitrification. (Author's abstract)
W91-00834

COMPARISON OF GROWTH AND NUTRIENT REMOVAL EFFICIENCY OF CHLORELLA PYRENOIDOSA IN SETTLED AND ACTIVATED SEWAGES.
Hong Kong Polytechnic, Kowloon. Dept. of Ap-

plied Biology and Chemical Technology.
N. F. Y. Tam, and Y. S. Wong.
Environmental Pollution ENPOEK, Vol. 65, No. 2, p 93-108, 1990. 5 fig, 2 tab, 31 ref.

Descriptors: *Activated sludge, *Chlorella, *Nitrogen removal, *Nutrient removal, *Wastewater treatment, Algae, Cultures, Culturing techniques, Denitrification, Effluents, Hong Kong, Nutrients, Wastewater.

The microscopic green alga, Chlorella pyrenoidosa was grown in settled and activated sewage under two different culture systems, batch and semi-continuous. Good growth was obtained in both types of wastewater and the algal production was comparable to and even higher than that found in commercial Bristol medium. The semi-continuous culture supported more growth than the batch system. There was a close relationship between algal growth and the amount of nutrient removed from both settled and activated sewage. A more rapid drop in NH4(+)-N was found in settled rather than activated sewage; from an initial 27 mg/L to 5 mg/L in both culture systems. On the other hand, the NO3(-)-N of activated sewage started to decrease from day 2 onward; the final NO3(-)-N concentration was <1 mg/L (over 90% removal efficiency). The amount of total inorganic nitrogen being reduced due to algal culture was similar to both types of sewage. The changes of phosphate content followed the same trend in both sewages; the P concentration increased slightly in the first two days then decreased, especially in the semi-continuous cultures. The final ortho-P in the sewages treated by Chlorella in semi-continuous culture was < 5 mg/L (about 62% reduction). Such removal efficiency was slightly lower than those reported in previous studies. In general, the semi-continuous algal culture appeared to be a more suitable and efficient way for wastewater treatment than the batch system. With Chlorella cells, there was no significant difference between settled and activated sewage. (Author's abstract)
W91-00857

BACTERIA DEGRADING PHENOLIC ACIDS ISOLATED ON A POLYMERIC PHENOLIC PIGMENT.
Granada Univ. (Spain). Dept. of Microbiology.
J. Perez, A. Ramos-Cormenzana, and J. Martinez.
Journal of Applied Bacteriology JABAA4, Vol. 69, No. 1, p 38-42, July 1990. 4 tab, 20 ref.

Descriptors: *Bacterial physiology, *Biodegradation, *Industrial wastewater, *Phenols, *Wastewater treatment, Bacteria, Farm wastes, Metabolites, Pseudomonas, Soil bacteria.

A high proportion of the organic matter in wastewater from olive oil extraction plants consists of pigments of a phenolic nature. Thirty-eight bacterial strains were isolated from the wastewater of olive oil mills, olives and soil in chemically-defined media containing the pigment of these wastes as the sole carbon source. Most of the organisms were Pseudomonas species. Four of the six phenolic acids associated with polymeric pigments in olive oil waste degradation were used by three strains. Only one Pseudomonas strain was able to use five acids. Strains degrading a great number of acids in extent, and metabolizing methoxylated aromatics (associated with lignin degradation and possibly also to pigment transformation) could prevent undesirable properties in wastewater from olive oil mills which are a result of its phenolic content. (Hoskin-PTT)
W91-00873

EFFECT OF WITHDRAWAL OF MORPHOLINE FROM THE INFLUENT AND ITS REINSTATEMENT ON THE PERFORMANCE AND MICROBIAL ECOLOGY OF A MODEL ACTIVATED SLUDGE PLANT TREATING A MORPHOLINE-CONTAINING INFLUENT.
Leeds Univ. (England). Dept. of Microbiology.
V. R. Brown, and J. S. Knapp.
Journal of Applied Bacteriology JABAA4, Vol. 69, No. 1, p 43-53, July 1990. 4 fig, 39 ref.

Descriptors: *Activated sludge process, *Biological wastewater treatment, *Chemical wastes, *Microbial degradation, *Microorganisms, *Morpholine, *Wastewater treatment, Genetics, Industrial wastes, Mycobacterium, Wastewater facilities.

Biological treatment is the method of choice for effluents from chemical manufacture, but it can be complicated by the variability (both quantitative and qualitative) which is often characteristic of such effluents. An activated sludge plant was established which was capable of treating an influent containing morpholine. When this compound was deleted from the influent the ability of the activated sludge to degrade morpholine was reduced. This reduction took the form of an increase in the length of the lag period before morpholine degradation was detected in a die-away test from 0 to ca. 100 h. The decreased ability of the activated sludge to degrade morpholine was accounted for by a decline in the specific population of morpholine-degrading microbes. In this activated sludge all morpholine degraders were Mycobacterium species. In the absence of morpholine in the influent most mycobacteria in the activated sludge retained their morpholine-degrading phenotypes. This is despite the fact that some of these organisms can lose this phenotype when grown under non-selective conditions. It is likely that the problem of loss of or decline in a specific degradative capability of activated sludge is very widespread and results in inefficient treatment of many effluents particularly those containing industrial effluents. Problems will be more acute where a compound is degraded only by slow-growing microbes and their severity will probably be related to the prevailing sludge age. (See also W91-00875) (Hoskin-PTT)
W91-00874

INSTABILITY OF THE MORPHOLINE-DEGRADATIVE PHENOTYPE IN MYCOBACTERIA ISOLATED FROM ACTIVATED SLUDGE.
Leeds Univ. (England). Dept. of Microbiology.
V. R. Brown, J. S. Knapp, and J. Heritage.
Journal of Applied Bacteriology JABAA4, Vol. 69, No. 1, p 54-62, July 1990. 3 fig, 38 ref.

Descriptors: *Activated sludge, *Biological wastewater treatment, *Microbial degradation, *Morpholine, *Mycobacterium, *Plasmids, *Wastewater treatment, Chemical wastes, DNA, Genetics, Industrial wastes, Microorganisms.

The stability of the morpholine-degradative phenotype was studied in a group of nine distinct strains of mycobacteria, all isolated from an activated sludge plant treating morpholine. Variants incapable of morpholine degradation arose from all strains at high frequency following growth under non-selective conditions. However, strains differed with respect to the frequency at which Mor(-) variants arose. No spontaneous reversion to wild type could be demonstrated. Six of the nine mycobacterial strains contained plasmids, each had a different plasmid profile. The plasmid profiles of wild type and Mor(-) variants were compared. In no case could loss of the ability to grow on morpholine be correlated with loss of a complete plasmid. However, the evidence suggests that in two strains loss of the morpholine-degradative phenotype may be correlated with a decrease in the size of a very large plasmid implying deletion of the DNA encoding morpholine degradation. A large number of methods have been employed to screen for plasmid DNA but, as most studies use only one method, few comparisons between them are available. In this study the method of Bennett was found to give comparable results to a CsCl/ethidium bromide density gradient centrifugation technique. The method of Kado and Liu was also tested but found to be inferior to that of Bennett. (See also W91-00874) (Hoskin-PTT)
W91-00875

STANDARD HANDBOOK OF HAZARDOUS WASTE TREATMENT AND DISPOSAL.
McGraw-Hill Book Company, New York. 1989. 1036p. Edited by Harry M. Freeman.

Descriptors: *Handbooks, *Hazardous waste disposal, *Hazardous wastes, *Waste disposal, *Waste treatment, Environmental engineering, Environmental protection, Land disposal, Legal aspects, Recycling, Sampling techniques, Waste recovery.

The major environmental issue for industrial countries throughout the 70s and 80s has been the management of hazardous wastes. This issue has manifested itself in the form of two questions: how to prevent environmental deterioration caused by the generation of hazardous wastes, and how to effectively clean up the problems caused by past examples of improper disposal. Both of these questions are complex, depending for resolution on many social and technical factors. This handbook has been developed to be used as a reference book for engineers, industrial managers, government officials, researchers, teachers, and others involved with the management and disposal of hazardous chemical wastes. Subjects covered include: laws and regulations; hazardous-waste characteristics, quantities, and treatment capacities; hazardous waste topics and issues; special hazardous wastes; waste minimization and recycling; hazardous-waste recovery processes; physical and chemical treatment; thermal processes; biological processes; land storage and disposal; comprehensive hazardous-waste treatment facilities; remedial-action techniques and technology; sampling and analysis techniques for hazardous waste; and engineering considerations. (See W91-00901 thru W91-00960) (White-Reimer-PTT)
W91-00900

ACTIVATED-CARBON ADSORPTION.
Michigan State Univ., East Lansing. Dept. of Civil and Environmental Engineering.
T. C. Voice.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. 6.3-6.21, 6 fig, 19 ref.

Descriptors: *Activated carbon, *Adsorption, *Hazardous waste treatment, *Wastewater treatment, Organic compounds, Pollutants, Process design.

Activated-carbon adsorption can be used to remove a wide variety of contaminants from liquid or gaseous streams. It is most frequently used for organic compounds although some inorganic species are also efficiently adsorbed. A variety of attractive forces exists between fluid-phase molecules and the molecules of a solid adsorbent, all having their origin in the electromagnetic interactions of nuclei and electrons. Activated carbon can be manufactured from a number of carbonaceous raw materials including coal, coke, peat, wood and nutshells. A summary of the properties of the adsorbate, adsorption equilibria, and adsorption kinetics is presented. The manner in which the adsorbate is exposed to the adsorbent is an important design consideration. The different reactor configurations include completely mixed reactors, column reactors, and combined adsorption and biological treatment processes. Carbon adsorption should be considered as a potential removal process for organic contaminants that are nonpolar, of low solubility, or of high molecular weight. In order to determine the specific process design it is necessary to conduct studies for: (1) pretreatment and treatability; (2) pilot-scale and full-scale design; (3) regeneration; and (4) cost estimates. Operational considerations will include performance monitoring and the determination of operational problems such as head loss, biological growth, and premature exhaustion of the carbon capacity. (See also W91-00900) (White-Reimer-PTT)
W91-00912

DISTILLATION.
Research Triangle Inst., Research Triangle Park, NC.
T. N. Rogers, and G. Brant.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 6.23-6.38, 7 fig, 7 ref.

Descriptors: *Distillation, *Hazardous waste treatment, *Industrial wastes, *Wastewater treatment, Batch distillation, Continuous distillation, Design criteria, Economic aspects.

Broadly defined, distillation is the separation of more volatile materials from less volatile materials by a process of vaporization and condensation. Distillation systems vary in complexity from simple batch processes to very sophisticated multiple-column units, with the system configuration depending on the objectives of the operation. Distillation can be conducted in one of two possible modes: batch or continuous. Most large-scale industrial applications utilize continuous distillation; however, batch distillation can prove to be advantageous in some situations. In distillation processes, the number of plates or stages required for a given separation is dependent on the reflux rate. As the reflux is increased, the required number of stages falls. When selecting the best equipment designs for the process, consideration may be given to such factors os fouling tendency, corrosivity, throughput, versatility, and cost. The following pieces of hardware and equipment variations are available and may be needed to meet different process conditions: (1) column shell; (2) column internals; (3) control instruments; (4) reboiler; (5) condenser; (6) preheaters and coolers; (7) vent condensers; and (8) pumps. Operating costs are highly variable depending on the complexity of the system. Based on a case study it was found that distillation tends to be energy-intensive and thus expensive unless the product can be recycled or sold. From an environmental standpoint distillation has the potential for both volatile-organic air emissions and process residuals. Generally vent condensers and incineration can be used to avoid discharge and disposal problems. (See also W91-00900) (White-Reimer-PTT)
W91-00913

ELECTROLYTIC RECOVERY TECHNIQUES.
General Motors Technical Center, Warren, MI.
A. A. Aguwa, and C. N. Haas.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 6.39, 3 fig, 9 ref.

Descriptors: *Electrochemistry, *Electrolytic recovery, *Hazardous waste treatment, *Heavy metals, *Waste recovery, *Wastewater treatment, Case studies, Costs, Industrial wastes.

Electrolytic techniques have been used to recover a variety of heavy metals from process streams or rinse waters. These processes have been demonstrated for the recovery of gold, silver, cadmium, nickel, nickel-iron alloy, copper, zinc, and other metals. The conventional electrochemical reactor consists of the electrodes, associated appliances such as recirculation pumps, and a power supply. The advantages of the recovery technique include: (1) valuable metals are recovered, re-used, or sold; (2) discharge of toxic heavy metals is reduced or eliminated; (3) initial investment for the process is low; (4) production of toxic sludges is eliminated; (5) operating expenses are low; and (6) equipment maintenance is minimal. Parameters that affect the recovery of metals using electrochemical means are the initial concentration of the metal, power supply, and characteristics of the electrodes. Case studies indicate that many metals can effectively and economically be recovered using electrolytic techniques. The capital cost of electrolytic recovery equipment depends on the flow rate, initial metal concentration, desired effluent concentration, and whether the metal is complexed. The operational cost depends on the cost of electricity, cost of pumps, and labor costs for cell operation and maintenance. (See also W91-00900) (White-Reimer-PTT)
W91-00914

HYDROLYSIS.
BDT, Inc., Clarence, NY.
A. Wilds.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 6.47-6.58, 3 fig.

Descriptors: *Hazardous materials, *Hazardous waste disposal, *Hazardous waste treatment, *Hydrolysis, *Waste treatment, *Wastewater treatment, Case studies, Chemical reactions, Economic aspects.

Hydrolysis can remove reactivity from organic and inorganic substances in the gas, liquid, or solid phase. The technology is based on the fact that water, under controlled conditions, modifies certain reactive chemical elements and compounds safely. Furthermore, the resultant species can be handled safely. Hazardous chemicals, such as potassium metal and lithium amide can be reacted to produce less hazardous substances. In the process, solutions with high or low pH may be produced, as well as toxic and flammable gases. The evolved gases must be handles appropriately and the pH of the solutions must be adjusted to more neutral values to render them safe for processing at a commercial wastewater-treatment facility. Any solids filtered from the solution can be drummed and sent to a secure landfill. A case study involving carbides is presented which includes the chemical reactions, process description, and equipment needed. Safety and monitoring are important considerations. During processing, reactive materials can produce explosive (methane, propane, butane, acetylene, ethylene oxide) and toxic (hydrogen cyanide, hydrogen sulfide, hydrogen bromide, phosgene, chlorine) gases. All of these materials and many others can cause fatalities or serious health problems. A major advantage of the hydrolysis technology is that it can be designed to be totally self-contained for solids and liquids. Consequently, the potential for contaminating the local groundwater, rivers, lakes, or land is reduced to an extremely low probability. There is no known technology that compares with hydrolysis in the range of reactives to which it can be successfully applied. Although the costs associated with hydrolysis are high, it has the advantage of being able to treat open or closed packages without the risk of handling accidents. (See also W91-00900) (White-Reimer-PTT)
W91-00915

ION EXCHANGE.
Eco-Tec Ltd., Pickering (Ontario).
C. J. Brown.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 6.59-6.75, 5 fig, 3 tab, 34 ref.

Descriptors: *Hazardous materials, *Hazardous waste treatment, *Ion exchange, *Waste treatment, *Wastewater treatment, Effluent polishing, Electroplating industry, Metal recovery.

Ion exchange is a very versatile and effective tool for the treatment of aqueous hazardous wastes. The process is usually carried out cyclically, alternating between service and regeneration modes, and can be either manually or automatically controlled. Ion-exchange resins can be described simply as solid, insoluble acids or bases which are capable of entering into chemical reactions in the same way as their mineral or organic acid analogs. Although it is possible to conduct ion-exchange reactions 'batch' style in stirred tanks, it is generally more efficient to operate the resin in vertical columns in which the resin is 'fixed.' Several different fixed-bed ion-exchange equipment types, with different column designs and process flowsheets, are being used in the treatment of hazardous wastes. Broadly speaking, these can be grouped into four classes: cocurrent, countercurrent, short bed, and mixed bed. One of the industries that is most beset by hazardous-waste disposal problems is the electroplating industry. Ion-exchange has been used in this industry for: (1) recovery of chromic acid from plating rinsewater; (2) recovery of metals from acid copper-plating and nickel-plating rinsewater; (3) recovery of metals from mixed rinsewater; and (4) effluent polishing. It has also been used in the nuclear industry for radioactive wastes. Recent advances in the field include the development of synthetic adsorbents, inclusion polymers, molecular-sieve zeolites, the Devoe-Holbein process, and centralized ion-exchange recovery systems. (See also W91-00900) (White-Reimer-PTT)
W91-00916

SOLVENT EXTRACTION.
Risk Science International, Washington, DC.
J. B. Berkowitz.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. 6.77-6.89, 1 fig, 2 tab, 25 ref.

Descriptors: *Hazardous materials, *Hazardous waste treatment, *Oil wastes, *Solvent extraction, *Waste treatment, *Wastewater treatment, Petroleum, Phenols, Separation techniques.

Solvent extraction is a physical separation process, used for the transfer of constituents from one liquid solution (or solid matrix) to another. The constituents are unchanged chemically. The principal waste-treatment application of solvent extraction is removal of phenols from wastewater effluents from petroleum-refinery, coke-oven, and phenol-resin plant operations. Suitable extraction solvents include crude oil, light oil, benzene, toluene, isopropyl ether, tricresyl phosphate, methyl isobutyl ketone, methyl chloride, and butyl acetate. The phenols transferred to the solvent phase can be recovered by subsequent extraction with caustic. Removal efficiencies are typically in the range of 90 to 98% and can exceed 99% in some applications with the use of special equipment. The four basic components of a solvent extraction process are: (1) solvent-feed contact; (2) extract and raffinate separation; (3) extract treatment; and (4) raffinate treatment. In designing the process it is necessary to consider energy and materials requirements; process efficiency; emissions and residuals management; recovery; safety; costs; and regulations. (See also W91-00900) (White-Reimer-PTT)
W91-00917

MEMBRANE SEPARATION TECHNOLOGIES.
Environmental Strategies Corp., San Jose, CA.
J. MacNeil, and D. E. McCoy.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 6.91-6.106, 10 fig, 4 tab.

Descriptors: *Hazardous waste treatment, *Membrane processes, *Separation techniques, *Wastewater treatment, Electrodialysis, Hyperfiltration, Membranes, Reverse osmosis, Ultrafiltration.

Membrane separation processes include reverse osmosis, ultrafiltration, hyperfiltration, and electrodialysis, each of which separates a contaminant (solute) from a liquid phase (solvent, typically water). Membrane separation processes can function in several ways: volume reduction, recovery and/or purification of the liquid phase, and concentration and/or recovery of the contaminant or solute. When choosing a membrane separation technique, a number of basic characteristics should be taken into account. Reverse osmosis is primarily used to separate water from a feed stream containing inorganic ions. The purity of the recovered water is relatively high, and the water is generally suitable for recycling. The maximum achievable concentration of salt in the reject stream is usually about 100,000 mg/L because of the osmotic-pressure considerations. Hyperfiltration separates ionic or organic components from water by limiting the size of membrane pores through which a contaminant can pass. It is typically used to remove contaminants having a molecular weight of 100 to 500 from water. Ultrafiltration is primarily used to separate organic components from water according to the size (molecular weight) of the organic molecules. Membranes are manufactured with the capability to remove contaminants with molecular weights between 500 and 1,000,000. Electrodialysis is used to remove ionic components from water. It produces moderate-quality product water (i.e., several hundred mg/L salt), and is capable of producing concentrate streams containing up to 20% salt. (See also W91-00900) (White-Reimer-PTT)
W91-00918

AIR STRIPPING AND STEAM STRIPPING.
Polaroid Corp., Cambridge, MA.
J. V. Boegel.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Com-

pany, New York. 1989. p 6.107-6.118, 3 fig, 1 tab, 20 ref.

Descriptors: *Air stripping, *Hazardous materials, *Hazardous waste treatment, *Steam stripping, *Wastewater treatment, Alcohols, Chlorinated hydrocarbons, Distillation, Industrial wastes, Ketones, Volatile organic compounds.

Stripping is a physical unit operation in which dissolved molecules are transferred from a liquid into a flowing gas or vapor stream. The driving force for mass transfer is provided by the concentration gradient between the liquid and gas phases, with solute molecules moving from the liquid to the gas until equilibrium is reached. Air stripping is useful for the removal of volatile organic compounds (VOCs) from water or aqueous waste streams. These include chlorinated solvents like methylene chloride, tetrachloroethylene, and 1,1,1-trichloroethane; aromatic solvents like benzene and toluene; and trihalomethanes. Air stripping applications are limited to dilute liquid aqueous wastes with volatile-organic concentrations less than about 100 mg/L. In its simplest form, air stripping converts a water-pollution problem to an air-pollution problem. Current research in the technology of air stripping includes (1) the development and demonstration of improved packings and (2) experimental work on high-temperature air stripping. Like air stripping, steam stripping can be used to remove VOCs from water or aqueous waste streams; however, steam stripping is more broadly applicable. Steam stripping has been successfully demonstrated for the decontamination of a groundwater containing ketones and alcohols as well as chlorinated solvents at 1,000 ppm. Steam stripping may be employed for the treatment of industrial wastewaters, particularly where the organic contaminants can be recovered for reuse or concentrated for more efficient destruction on site. Since steam stripping is essentially a distillation process, the design equations and methodology developed for continuous fractional distillation applies. Steam stripping produces a treated bottoms stream suitable for appropriate discharge to a municipal sewage-treatment system or into surface water, or for reuse in on-site industrial processes. (See also W91-00900) (White-Reimer-PTT)
W91-00919

THIN-FILM EVAPORATION.
Research Triangle Inst., Research Triangle Park, NC.
C. C. Allen, and S. I. Simpson.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 6.119-6.131, 4 fig, 6 tab, 5 ref.

Descriptors: *Hazardous materials, *Hazardous waste treatment, *Thin-film evaporation, *Waste treatment, *Wastewater treatment, Economic aspects, Organic compounds, Solvents, Thin films, Waste recovery.

Thin-film evaporators can be used to remove or recover organic components from waste streams. This includes the recovery of high-boiling water-soluble solvents such as ethylene glycol, without adding water to the recovered product. Hazardous wastes which can be treated in a thin-film evaporator include waste solvents from the chemical, plastics, electronics, and pharmaceutical industries. Both halogenated and nonhalogenated organics can be recovered. Thin-film evaporators do not work well for wastes which react immediately when heated, or for extremely viscous materials. A major advantage of thin-film evaporators is that organic compounds can be recovered from viscous liquids. Disadvantages include the need to leave a fraction of the organics in some sludges to maintain fluidity. In designing the process the following must be considered: (1) capacities, flows, and other specification; (2) possible efficiencies, and capabilities; (3) construction materials; (4) maintenance; (5) relation to other processes; and (6) utility support. A thin-film evaporation system has three streams which exit the system--the distillate which has evaporated and then condensed back to the liquid phase, the concentrates stream which was not evaporated, and the noncondensible gases which are vented from the condenser. Often only 85 to 90% of the organics are recovered. In some cases the residual sludge has been landfilled and burned for its fuel content. Economic evaluations considered in the process design include capital, operating, and maintenance costs. (See also W91-00900) (White-Reimer-PTT)
W91-00920

FREEZE-CRYSTALLIZATION.
Heist Engineering Corp., Raleigh, NC.
J. A. Heist.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. 6.133-6.143, 4 fig.

Descriptors: *Freeze-crystallization, *Hazardous materials, *Hazardous waste treatment, *Waste treatment, *Wastewater treatment, Air pollution, Economic aspects, Waste disposal.

A freeze-crystallization process separates water from solutions by cooling the solution until ice crystals begin to form. Ice, with few exceptions, crystallizes as a pure material. The ice is separated from the remaining liquid and impurities, washed, and melted to produce a purified stream. The dissolved components of the stream are concentrated into a reduced volume. The cost is typically $0.025 to $0.15 per gallon of purified water, including equipment amortization. Hazardous components of liquid wastes are concentrated into a smaller volume, which can be more economically destroyed by thermal oxidation or solidified. The flexibility of the freeze-crystallization process enhances its integration with both the generating and the disposal processes. The design variables for freeze-crystalization equipment fall into three categories: (1) process characteristics, dictated by the application; (2) production objectives, which are often an optimization of the total costs of freeze-crystallization and final disposal; and (3) equipment and process options. In the area of environmental concerns it has been determined that there are virtually no air emissions from the process, wastewaters generally meet requirements and are easily monitored, and solids discharged from the process can be directly landfilled. (See also W91-00900) (White-Reimer-PTT)
W91-00921

FILTRATION AND SEPARATION.
Memtek Corp., Billerica, MA.
L. S. Liang.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.3-7.19, 4 fig, 3 tab, 27 ref.

Descriptors: *Filtration, *Hazardous waste treatment, *Separation techniques, *Waste treatment, *Wastewater treatment, Case studies, Clarification, Design criteria, Dewatering, Industrial wastes.

Filtration is a method for separating solid particles from a fluid through the use of a porous medium. The applications of filtration to treatment of hazardous waste fall into two categories: clarification, in which suspended solid particles in concentrations of typically less than 100 ppm are removed from an aqueous stream; and dewatering of slurries of typically 1 to 30% solids by weight. The processes used include granular-bed filters, rotary vacuum belt filters, rotary vacuum precoat filters, filter presses, and bed filter presses. Design considerations for any specific application include: (1) design constraints; (2) capacities and capabilities; (3) construction materials; and (4) relation to other processes. Air emissions from filtration processes exposed to the atmosphere can occur if there are volatile components in the wastewater or sludges. The filtrate from granular-media filters, vacuum precoat filters, and cross-flow filters may be clean enough to be recycled as service water in the waste treatment plant. Metals in filter cakes from dewatering processes may be recovered economically, depending on the composition of the cake. Filtration and separation processes have been successfully used in the manufacture of organic chemicals, plastics, and fibers; metal-forming and plating operations; arsenic-sludge dewatering; and dewatering of textile-waste activated sludge. (See also W91-00900) (White-Reimer-PTT)
W91-00922

CHEMICAL PRECIPITATION.
Metcalf and Eddy, Inc., Wakefield, MA.
N. K. Chung.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.21-7.31, 3 fig, 2tab, 3 ref.

Descriptors: *Chemical precipitation, *Hazardous waste treatment, *Waste treatment, *Wastewater treatment, Design criteria, Heavy metals, Industrial wastes, Metal-finishing wastes, Precipitants.

Chemical precipitation is a process by which a soluble substance is converted to an insoluble form either by a chemical reaction or by changes in the composition of the solvent to diminish the solubility of the substance in it. The precipitated solids can then be removed by settling and/or filtration. Chemical precipitation is applicable to the treatment of aqueous hazardous wastes containing toxic constituents that may be converted to an insoluble form. This includes wastes containing the metals arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc. Major industries that are sources of metal-containing wastes are metal plating and polishing, steel and nonferrous metals, inorganic pigments, mining, and the electronics industry. Hazardous wastes containing metals are also generated from cleanup of uncontrolled hazardous-waste sites. A chemical precipitant is added to the metal-containing aqueous waste in a stirred reaction vessel. Different chemical precipitants that have been shown to be effective in removing heavy metals from aqueous wastes include hydroxide, sulfide, carbonate, sodium borohydride, cementation, and others. The design considerations and alternatives related to the use of precipitation for treatment of hazardous wastes are associated either with the precipitation processes themselves or with the nature of the hazardous metal-bearing wastes to be treated. These considerations and alternatives include waste segregation and pretreatment, jar testing, lime or caustic, heat of reaction, and precipitation of complexed metals. (See also W91-00900) (White-Reimer-PTT)
W91-00923

PHOTOLYSIS.
Agricultural Research Service, Beltsville, MD. Natural Resources Inst.
P. C. Kearney, and P. H. Mazzocchi.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.33-7.40, 3 fig, 1 tab, 18 ref.

Descriptors: *Hazardous waste treatment, *Photolysis, *Waste treatment, *Wastewater treatment, Dioxins, Munitions wastes, Pesticides, Photochemical processes.

Photochemical processes that can be effectively employed to photodegrade selected hazardous wastes are described. Various techniques like the use of sensitizers and commercial high-intensity light sources, which effectively remove the wavelength limitation of sunlight, make the large-scale photodegradation of hazardous wastes a viable process. An important parameter in determining the efficiency of a photochemical reaction is the quantum yield. Quantum yield is defined as the ratio of the number of molecules of material undergoing that process to the number of quanta light absorbed. Photochemical equipment generally consists of two components: a vessel to contain the material being irradiated, and the light source. For most purposes low-pressure or medium-pressure mercury lamps are most convenient for large-scale reactions. Applications of photochemical processes include removal of pesticides, dioxins, and munitions. Some of the pesticide products of photolysis may pose some potential toxicological problems even though they are less toxic than the starting material. Consequently it may be advantageous to

have a secondary treatment process that mineralizes the photoproducts to CO2, H2O, and Cl. There is very limited information on the costs of destroying toxic wastes by photolysis. The capital costs can be substantial depending on the equipment used. (See also W91-00900) (White-Reimer-PTT)
W91-00924

CHEMICAL OXIDATION AND REDUCTION.
Chemical Waste Management, Inc., Riverdale, IL.
E. G. Fochtman.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.41-7.51, 5 tab, 16 ref.

Descriptors: *Chemical reduction, *Chemical treatment, *Chromium, *Hazardous waste treatment, *Oxidation, *Waste treatment, *Wastewater treatment, Metals, Organic wastes, Oxidation reagents, Reduction reagents.

Chemical oxidation-reduction reactions are those reactions in which the oxidation state of one reactant is increased and the oxidation state of another reactant is decreased. Oxidation-reduction or 'redox' reactions have an important role in treatment of waste. Such reactions are used in treatment of metal-bearing wastes and of inorganic wastes such as metal-containing wastes, sulfides, cyanides, and chromium, and also in the treatment of many organic wastes such as phenols, pesticides, and sulfur containing compounds. Chemical oxidation is widely used to treat both hazardous and nonhazardous wastes. The technology is well-established and represents a safe means of waste treatment that is easily monitored and controlled. The most prevalent use of reduction in current waste treatment is the reduction of chromium(VI) to chromium(III). The Cr(3+) is much less toxic than Cr(6+) and can be precipitated as the relatively insoluble Cr(OH)3 for removal. Commonly used oxidizing agents include sodium hypochlorite, hydrogen peroxide, calcium hypochlorite, potassium permanganate, and ozone. The most common reducting agents are sulfur dioxide and sodium borohydride. In general, chemical treatment costs are highly influenced by the chemical cost. Thus, oxidation and reduction treatment tends to be most suitable for low concentrations (less than 1%) in wastes. (See also W91-00900) (White-Reimer-PTT)
W91-00925

DEHALOGENATION.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
A. Kornel.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.53-7.63, 1 tab, 34 ref.

Descriptors: *Dehalogenation, *Dioxins, *Hazardous waste treatment, *Polychlorinated biphenyls, *Waste treatment, *Wastewater treatment, Oil, Soil contamination.

The application of chemical dehalogenation reactions for the purpose of detoxification or destruction of hazardous compounds is a relatively recent phenomenon. Perhaps the best-known problem compounds of current times are the polychlorinated biphenyls (PCBs), their mixtures, and the polychlorinated dibenzodioxins (PCDDs). The commercial process for decontamination of PCB-laden dielectric, heat-exchange, or hydraulic fluids represent a classical case of application of chemical dehalogenation. Proven commercial processes exist for PCB dehalogenation in oils; however, these processes have major limitations when their use is attempted in any other matrix--e.g. soils or sediments which contain water or are exposed to atmospheric oxygen. One of the first groups to research this area applied a new dehalogenation reagent, NaPEG, for possible in situ dehalogenation of PCBs in soils. Soil studies employing this reagent under laboratory conditions showed promise for the reagents ability to perform under in situ conditions. However field studies revealed a greater susceptibility to water deactivation than had previously been expected. The NaPEG reagent and other similar reagents developed all employ alkaline polyethylene glycolates (APEGs) as the reactive species. There are a number of groups who are investigating innovative and novel dehalogenation techniques. These techniques include catalytic (low-temperature) and electrochemical processes and are all directed at dehalogenation of PCBs, though they may be applied toward other haloorganics. Some concern is now being given to the presence of aliphatic halogenated solvents in ground and drinking water. As chemists have not until recently been asked to look at these problems, there are no specific solutions. There are, however, applications of existing technologies which could render a solution to these problems. (See also W91-00900) (White-Reimer-PTT)
W91-00926

OZONATION.
H2M Corp., Melville, NY.
F. C. Novak.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.65-7.76, 4 fig, 8 ref.

Descriptors: *Hazardous waste treatment, *Ozonation, *Waste treatment, *Wastewater treatment, Case studies, Disinfection, Economic aspects, Inorganic compounds, Organic compounds, Oxidation.

Ozone has been used for more than 80 years, primarily for disinfection of municipal drinking water. Ozone treatment has also been used for industrial and hazardous-waste applications, and organic and inorganic reactions. Ozone is relatively unstable, but one of the strongest oxidizing agents known. It can be substituted for conventional oxidants such as chlorine, hydrogen peroxide, and potassium permanganate. Since hazardous wastewaters are normally complex, laboratory and/or pilot-plant studies are needed to determine if ozone is feasible for use with a specific waste. Ozone utilization, or transfer efficiency, is determined by a number of factors such as wastewater characteristics, kinetics, pH, and temperature. Advantages of using ozone include: it is generated on site from air with no storage or handling needed; strong oxidation properties and reaction with a wide variety of organics and inorganics; and less critical temperature and pH constraints than other oxidants. The disadvantages of using ozone are a higher capital cost, inability to degrade low-molecular-weight chlorinated organics, and residual oxidant (ozone) is essentially nonexistent. Considerations necessary for designing a system include: background information on ozone equipment; materials of construction; pressure, temperature, and dew point; and monitoring and control. All ozone systems should include some type of ozone-destruction equipment to prevent excess ozone from entering the environment. Ozonation has been used successfully in the auto industry for cyanide destruction, textile wastewater treatment, and at hazardous waste sites. Capital costs can vary as much as 50% depending on the interpretation of ozone-generator performance specifications. Ozone-generator operating costs depend primarily on the cost of electrical energy. (See also W91-00900) (White-Reimer-PTT)
W91-00927

EVAPORATION.
Ground/Water Technology, Inc., Rockaway, NJ.
B. T. Delaney, and R. J. Turner.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.77-7.84, 3 fig.

Descriptors: *Evaporation, *Hazardous waste treatment, *Waste treatment, *Wastewater treatment, Design criteria, Economic aspects, Inorganic compounds, Metal-finishing wastes, Organic compounds, Physicochemical properties, Radioactive wastes.

Evaporation has long been used as a unit operation in the manufacture of various products in the chemical-process industries. In addition, it is currently being used for the treatment of hazardous wastes such as radioactive liquids and sludges, metal-plating wastes, and other organic and inorganic wastes. Design choice is dependent on the liquid to be evaporated. This means that the waste stream must be completely characterized and relatively homogeneous in nature. The processes generally used for evaporation are called boiling heat transfer and flash vaporization. The three most common types of evaporation equipment are the rising-film, falling-film, and forced-circulation evaporators. The first two rely on boiling heat transfer and the latter relies on flash vaporization. Heat exchangers, flash tanks, and ejectors are common auxiliary equipment items incorporated with evaporator bodies to complete an evaporator system. Properties of the liquid to be evaporated are critical in final selection of an appropriate evaporator system. Since operating costs are a significant factor in overall cost, heat-transfer characteristics and energy requirements are important considerations. Properties of liquids which are critical to the determination of final design include: heat capacity, heat of vaporization, density, thermal conductivity, boiling point rise, and heat-transfer coefficient. Evaporation is an expensive technology, both in terms of capital costs and operating costs. Additionally, mechanical evaporation produces a condensate and a bottoms stream, one or both of which may require further processing or disposal. (See also W91-00900) (White-Reimer-PTT)
W91-00928

SOLIDIFICATION AND STABILIZATION TECHNOLOGY.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
C. C. Wiles.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 7.85-7.101, 2 fig, 3 tab, 14 ref.

Descriptors: *Hazardous waste treatment, *Physicochemical treatment, *Waste solidification, *Waste stabilization, Binders, Containment mechanisms, Design criteria, Land disposal, Waste management, Waste treatment.

Solidification and stabilization (S/S) are treatment processes designed to either improve waste-handling and physical characteristics, decrease surface area across which pollutants can transfer or leach, or limit the solubility of or detoxify the hazardous constituents. Advantages and disadvantages of S/S will vary with the process, the binders, the waste, the site conditions and other unique factors. Solidification and stabilization technology may be characterized by the binder used or by the binding or containment mechanism; or it may be categorized by process type. Binder systems consist of two categories: inorganic and organic. Pollutant binding mechanisms include: sorption, pozzolan reactions, pozzolan-portland cement reactions, thermoplastic microencapsulation, and macroencapsulation. The S/S processing schemes used are in-drum processing, inplant processing, mobile-plant processing, and in situ processing. Factors that affect the selection, design, implementation, and performance of S/S processes and products include treatment objective, waste characteristics, process type and processing requirements, S/S waste-management requirement, regulatory requirements, and economics. As restrictions on landfilling become stronger and wastes are banned from land disposal, S/S technology could potentially be an important alternative technology with a major use being to treat waste in order to make it acceptable for land disposal. Lower permeability, lower contaminate leaching rates, and similar characteristics may make hazardous wastes acceptable for land disposal after stabilization. (See also W91-00900) (White-Reimer-PTT)
W91-00929

LIQUID-INJECTION INCINERATORS.
Four Nines, Inc., Plymouth Meeting, PA.
J. J. Santoleri.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.3-8.18, 11 fig, 3 tab, 7 ref.

Descriptors: *Hazardous waste disposal, *Incineration, *Liquid-injection incinerators, *Waste treatment, Design criteria, Thermal properties, Waste characteristics, Waste disposal.

In the field of hazardous-waste incineration, there is more experience with liquid-injection incinerators than all other types combined. Liquid-injection incinerators are usually refractory-lined chambers, generally cylindrical and equipped with a primary combustor (waste and auxiliary-fuel fired) and often secondary combustors or injection nozzles for low-calorific-value materials (aqueous wastes containing either organic or inorganic compounds, or both). When considering the liquid-injection incinerator, one must be concerned about the ability of the entire system, i.e., the design, components, controls, and pollution-control system, to meet the requirements of the federal and state regulations. The physical, chemical, and thermodynamic properties of the waste must be considered in the basic design requirements of the total incinerator system. This includes storage tanks, mixers, pumps, control valves, piping, atomizers, combustors, refractory, heat recovery, quench system, and air-pollution control equipment. In the process industries, waste liquids are generated which are numerous in kind and defy easy definition. The wastes can be categorized as organic, aqueous organic, and aqueous organic-inorganic. Each of these can again be divided into those that are considered hazardous and those considered nonhazardous. A further distinction is made between aqueous organics with and without ash. Since most liquid-injection incinerators do not generate solids or ash, the air-pollution control problem is minimized. In most cases, it is a matter of providing the proper scrubber for absorption of the acid gases generated. The wastewater discharge is usually dependent on the acid gases formed in the incinerator, the ash composition and size, and the scrubber system employed. (See also W91-00900) (White-Reimer-PTT)
W91-00930

ROTARY KILNS.
Boliden Allis, Inc., Milwaukee, WI. Minerals Systems Div.
C. F. Schaefer, and A. A. Albert.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.19-8.30, 10 fig, 1 tab, 4 ref.

Descriptors: *Design criteria, *Hazardous waste disposal, *Incineration, *Rotary kilns, *Waste treatment, Heat transfer, Waste characterization.

Rotary kilns provide a number of functions necessary for incineration. They provide for the conveyance and mixing of solids, provide a mechanism for heat exchange, serve as host vessel for chemical reactions, and provide a means of ducting the gases for further processing. When designing a kiln to process solid hazardous wastes, it is first necessary to characterize the material to be processed as to chemical composition, specific heat, size consistency, calorific value, moisture content, bulk density, and dynamic angle of repose. The flow of material through a rotary kiln is determined by the kiln's slope and rotational speed as well as by the characteristics of the material being processed. The length-to-diameter ratio of the kiln determines how many supports are required. As the length-to-diameter ratio increases, additional supports may be required. Heat transfer appears to be proportional to the square of the kiln's internal diameter. The rules of thumb which attribute 60 to 80% of kiln heat transfer to radiation are presently under investigation. Numerous tests and demonstrations indicate that the bulk of the heat transfer may well be attributable to convective heat transfer. There are two categories of plants for processing solid hazardous wastes--permanent installations and transportable plants. Permanent installations are at the sites of generators of solid hazardous wastes, or are installed as regional facilities accepting wastes from multiple sources. Transportable facilities can be constructed in skid-mounted and/or wheel-mounted modules. This type of plant is most likely to be used to clean up existing abandoned dump sites. (See also W91-00900) (White-Reimer-PTT)
W91-00931

FLUIDIZED-BED THERMAL OXIDATION.
Waste-Tech Services, Inc., Golden, CO.
G. F. Rasmussen, R. W. Benedict, and C. M. Young.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.31-8.40, 6 fig, 13 ref.

Descriptors: *Fluidized bed process, *Hazardous waste disposal, *Thermal oxidation, *Waste treatment, Combustion, Design criteria, Economic aspects.

Fluidized beds offer an economical means for the safe thermal destruction of hazardous and toxic wastes. The technology is the choice in many cases where thermal oxidation is to be applied to many hazardous and toxic wastes. The reasons are: (1) its superior combustion environment created by the bed turbulence; (2) the 'thermal inertia' associated with the mass of the bed; (3) the process simplicity resulting from the lack of moving parts associated with the high-temperature vessel; and (4) the versatility of the technology, with capability to destroy solids, liquids, and sludges. Systems for fluidized-bed thermal oxidation of hazardous waste generally consist of the principal elements which may be segmented into the air fluidization system, fluidized-bed vessel, feed systems, and off-gas cleanup equipment. A variety of bubbling-type fluidized-bed designs exist. The primary environmental impacts of fluidized-bed combustion are air emissions and ash generation. Fluidized beds have a lower capital cost than rotary types of incinerators and are more expensive than liquid-injection incinerators. Operating costs of fluidized beds are comparable to those for rotary technologies. Maintenance costs are lower than for rotary technologies and comparable to those for liquid-injection systems. A major development area is the use of active beds rather than inert beds. A two-stage bed has been used with catalytic and dry off-gas cleanup applicability. (See also W91-00900) (White-Reimer-PTT)
W91-00932

CEMENT KILNS.
General Portland, Inc., Dallas, TX.
J. F. Chadbourne.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.57-8.75, 1 fig, 3 tab, 29 ref.

Descriptors: *Cement kilns, *Fuel, *Hazardous waste disposal, *Incineration, *Waste disposal, Alternative fuels, Cements, Regulations.

An overview of cement kilns is presented. Cement kilns are a versatile alternative for the management of a wide variety of hazardous wastes. Materials present in the feed, fuels, or hazardous waste introduces into the kiln become part of the cement product, become part of a waste material known as cement-kiln dust, or are converted to other forms within the kiln. With few exceptions, materials introduced into cement kilns will be oxidized and stabilized, requiring no further treatment. Both solid and liquid wastes can be used. Although cement kilns can accommodate a variety of materials both as fuel and as feed in the cement process, there are limitations on the use of hazardous-waste materials and there are materials which are not desirable in the cement process. Unacceptable materials can be divided into two categories: those which are technologically unacceptable because of process constraints, and those which are unacceptable because of public opinion. Cement kilns are manufactured in a variety of designs and sizes. However, the high temperatures and the chemistry of cement production are essentially the same in all cement kilns from the burning zone to the calcining zone. In the United States, hazardous-waste fuel is subject to federal regulations that require development of procedures to prevent hazards, contingency and emergency plans, personnel training, waste analysis, inspections, record keeping and manifesting of waste, and adequate spill containment to prevent or control releases to the environment. Comparative emission tests on kilns burning conventional fuels and hazardous waste fuels show that there is no significant change in air emissions when hazardous waste fuel is properly used to replace conventional fuels. (See also W91-00900) (White-Reimer-PTT)
W91-00933

WET OXIDATION.
Zimpro, Inc., Rothschild, WI.
W. M. Copa, and W. B. Gitchel.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.77-8.90, 6 fig, 4 tab, 23 ref.

Descriptors: *Hazardous waste treatment, *Oxidation, *Waste treatment, *Wet oxidation, Case studies, Economic aspects, Organic compounds, Thermal processes.

Wet oxidation is an aqueous-phase oxidation process brought about when an organic and/or oxidizable inorganic-containing liquid is mixed thoroughly with a gaseous source of oxygen (usually air) at temperatures of 150 to 325 C. The process may be carried out in a batch reactor, but usually a continuous-flow system is used. The elements of the systems are a high-pressure liquid-feed pump, oxygen source, reactor, heat exchangers, and process regulators. Most organic compounds are stoichiometrically oxidized, the carbon going to carbon dioxide, the hydrogen to water, any halogen to halides, any sulfur to sulfate, any phosphorus to phosphate, and any nitrogen to ammonia or elemental nitrogen. The most resistant compounds are the halogenated aromatics. Wet-oxidation equipment is available in four basic configurations for application of this technology to hazardous-waste treatment: (1) aboveground vertical-column reactor; (2) stirred-tank reactor; (3) supercritical water; and (4) underground vertical-tube reactor. Hazardous wastes are treated by wet oxidation for the purpose of detoxification. Ultimately two effluent streams, off gas and oxidized liquid effluent, exit from the wet-oxidation process. The liquid effluent can be further separated in some cases into a liquid fraction, with all soluble components, and insoluble solids. The environmental impact of these effluent phases--gas, liquid, and solid--must be addressed when considering wet oxidation for hazardous-waste treatment. In most cases where wet oxidation is applied to hazardous wastes, the treatment objectives are the detoxification of the wastewater for subsequent biological treatment, which can be accomplished in a publicly owned treatment works or an industrial treatment plant. Case studies are presented demonstrating the use of wet oxidation in a hazardous-waste disposal facility in California, chemical manufacturing wastes in Michigan, spent coke-oven gas in Ontario, and scrubbing liquors from an ethylene production facility in Illinois. Capital costs for wet oxidation depend on several factors such as capacity of the system, oxygen demand of the wastewater, severity of oxidation required to meet the treatment objectives, and materials of construction of the wet-oxidation system. (See also W91-00900) (White-Reimer-PTT)
W91-00934

PYROLYSIS.
Midland-Ross Corp., Toledo, OH. Surface Div.
J. K. Shah, T. J. Schultz, and V. R. Daiga.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.91-8.104, 9 fig, 4 tab.

Descriptors: *Hazardous waste treatment, *Incineration, *Pyrolysis, *Waste treatment, Carbonaceous material, Corrosion, Economic aspects, Thermal processes.

Pyrolysis is a thermal process for transformation of solid and liquid carbonaceous materials into gaseous components and a solid residue containing fixed carbon and ash. Pyrolysis is especially applicable to hazardous-waste treatment because it provides precise control of the combustion process. The pyrolysis process can be applied to solids,

sludges, and liquid wastes. Pyrolysis is an intermediate process step in thermal treatment of hazardous waste. It generates a gaseous stream and a solid residue. Environmental protection regulations require that all effluents from a hazardous-waste treatment facility be safely disposed. Pyrolysis processes can be carried out in a variety of furnace designs, such as: rotary hearth, rotary kiln roller hearth, roller rail, and car bottom. Pyrolyzer furnaces can either be direct-fired or they can be indirectly heated by radiant tubes or electrical heaters. Pyrolytic systems are normally custom-designed to treat a specific waste. It is advisable to use corrosion-resistant, high-temperature alloy steels for metallic components in contact with the corrosive, reducing (oxygen-deficient) atmosphere in a pyrolyzer. Capital cost and operating cost can vary with the type of waste to be processed and the degree of process sophistication required. (See also W91-00900) (White-Reimer-PTT)
W91-00935

OCEANIC INCINERATION.
SITEX Environmental, Inc., Research Triangle Park, NC.
D. G. Ackerman, and R. A. Venezia.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.105-8.120, 2 fig, 7 tab, 48 ref.

Descriptors: *Hazardous waste disposal, *Incineration, *Oceanic incineration, *Waste treatment, Air pollution, Case studies, Economic aspects, Liquid-injection, Organochlorines, Polychlorinated biphenyls.

Oceanic incineration of liquids is a straightforward adaptation of land-based technology. All oceanic incineration systems to date have been vertical liquid-injection units, but there have been several conceptual designs for horizontal liquid-injection units. Wastes burned at sea have been almost exclusively organochlorines because they are more costly to dispose of on land. Specific types of wastes burned at sea have included distillation ends from manufacture of vinyl chloride, herbicide Agent Orange, and mineral-oil dielectric fluid containing polychlorinated biphenyls (PCBs). Currently, only pumpable liquid wastes are suited for oceanic incineration, as existing vessels are not designed to burn solids. Oceanic incinerators have been straightforward adaptations of land-based technology. The principal difference between oceanic and land-based incinerators is that mounting an incinerator in a ship requires compactness in both envelope and height. Another major difference is that scrubbers are not required on oceanic incinerators because the sea has a buffering capacity more than adequate to neutralize acidic emissions and because incineration sites are located far enough from land that the emissions will not degrade buildings or other structures or adversely affect human health and welfare. Oceanic incineration has been shown not to cause measurable or adverse environmental effects when conducted in accordance with international regulations. Before certification, currently operating ships were tested for their ability to incinerate organochlorines, PCBs, and Agent Orange. Unit costs vary widely and depend on factors related to the specific waste, and to packaging, transportation, density of generators, and regulatory programs. (See also W91-00900) (White-Reimer-PTT)
W91-00936

MOLTEN-GLASS PROCESSES.
Battelle Pacific Northwest Labs., Richland, WA.
J. L. Buelt.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.121-8.136, 4 fig, 2 tab, 24 ref.

Descriptors: *Hazardous waste disposal, *Molten-glass processes, *Waste treatment, Economic aspects, Glass, Liquid organics, Nitrates, Solid wastes, Thermal processes, Vitrification.

Various molten-glass processes are becoming commercially available for the destruction and/or immobilization of hazardous wastes. Molten glass processes fall into the following three basic categories: in situ vitrification, vertical joule-heated glass melters, and horizontal joule-heated glass melters. The various processes available include: in situ vitrification; vertical glass melter; and horizontal glass melters. The destruction of wastes applies mainly to solid and liquid organics and nitrate-bearing chemicals associated with the waste. Immobilized constituents consist of heavy metals, radionuclides, combustion ash, and other nonvolatile and semivolatile constituents such as silica, alumina, and alkaline oxides. Because of the diversity of waste types, molten-glass processes, and scale of equipment, it is impossible to project reliable cost estimates for the molten-glass processes. Cost evaluations must be performed on a case by case basis. Extensive leach studies with waste glasses have shown the waste form to be highly stable, possessing leach characteristics better than granite, marble, and common bottle glass. (See also W91-00900) (White-Reimer-PTT)
W91-00937

DEEP-SHAFT WET-AIR OXIDATION.
Smith (J.M.) and Associates, Cincinnati, OH.
J. M. Smith.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.137-8.151, 7 fig, 6 tab,14 ref.

Descriptors: *Deep-shaft wet-air oxidation, *Hazardous waste treatment, *Oxidation, *Waste treatment, *Wet oxidation process, Chemical oxygen demand, Design criteria, Economic aspects, Performance evaluation, Waste disposal.

The concept and practice of wet oxidation of organic waste materials is well established in the United States. Configuration of the deep-shaft wet-air oxidation reactor is unique to its purpose. Wastewater flows down the center tube of two concentric vertical tubes and returns in the annular space. Deep-shaft wet-air oxidation can be classified as subcritical or supercritical. Subcritical oxidation refers to maximum operating reactor temperatures below the critical point of water, 374 C and 22,120 kN/sq m. The supercritical process for deep-shaft wet-air oxidation attains maximum reactor temperatures and pressures above the critical point of water. Performance data for a full-scale plant is available from the subcritical-temperature EPA-sponsored facility at Longmont, Colorado. The data released from the study show that 75 to 85% of the COD of the sludge is destroyed with remaining COD mainly as acetic acid; 90 to 96% of the volatile suspended solids (VSS) were destroyed. These results were obtained with a residence time of 45 to 50 min in the oxidation zone. According to the process owner, the observed demonstration-plant COD reductions exceeded laboratory bench-test results by 3 to 5%. Ash removed from the process has been tested and found to easily pass the extraction procedure toxicity test for heavy metals. The reactor for deep-shaft wet-air oxidation is constructed utilizing conventional oil-field equipment and installation techniques. Total costs have been projected for supercritical reactors processing 100 gpm to 750 gpm of wastes at detention times of 1 to 5 min. the costs for the process range from $0.07 to $0.15 per gallon of throughput. The cost of the supercritical reactor and the well amounts to approximately one-half of the total system cost. (See also W91-00900) (White-Reimer-PTT)
W91-00938

SUPERCRITICAL-WATER OXIDATION.
Modell Development Corp., Framingham, MA.
M. Modell.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.153-8.169, 3 fig, 3 tab, 28 ref.

Descriptors: *Hazardous waste treatment, *Oxidation, *Supercritical wet oxidation, *Waste treatment, *Wet oxidation process, Heat exchangers, Organic compounds, Reactors, Waste disposal, Water pressure.

Supercritical-water oxidation (SCWO) is the oxidation of organics, with air or oxygen, in the presence of a high concentration of water under temperatures and pressures above the critical-point values of water. In theory, SCWO is applicable to any waste stream containing organics: concentrated organic liquids, vapors, and solids; aqueous solutions containing dissolved or suspended organic; or inorganic solids with adsorbed organics. In practice, the applicability of the process may be limited by waste pressurization, char formation, or solids removal. Supercritical-water oxidation of organics is significantly superior to wet oxidation in destruction efficiency. The major advantages of operating supercritically are (1) enhanced solubility of oxygen and air in water; (2) rapid oxidation of organics in short residence times; (3) complete oxidation of organics; (4) potential removal of inorganic constituents as solids and brines; and (5) recovery of the heat of combustion as high-temperature process heat or power. The reactor and heat exchanger are the key components in the SCWO system and their design involves considerations of residence time, temperature, and materials of construction. SCWO produces aqueous and sometimes solid effluents. As with other oxidation processes, the key to success is avoiding upsets or off-spec conditions, which can lead to incomplete oxidation and contaminated effluents. Costs for SCWO may vary with throughput and heating value of the waste. (See also W91-00900) (White-Reimer-PTT)
W91-00939

PLASMA SYSTEMS.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
C. C. Lee.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.169-8.177, 4 fig, 2 tab, 4 ref.

Descriptors: *Hazardous waste treatment, *Plasma systems, *Plasmavarc, *Waste treatment, Design criteria, Dioxins, Economic aspects, Liquid-waste feed system.

Although plasma arc itself has been successfully applied in the metals industry for many years, application of the plasma arc to hazardous-waste destruction is still in a pilot-scale research stage. Initial test results have shown that the plasma arc is a promising alternative for destruction of difficult to treat wastes such as dioxin-contaminated sludges. The most common method of plasma generation is electrical discharge through a gas. The gas used is relatively unimportant in creating the discharge, but will ultimately affect the products formed. The major components of the process include a liquid-waste feed system, plasma torch, reactor, caustic scrubber, on-line analytical equipment, and flare. The key component is the electrodes to produce the necessary arc. A plasma-arc system generally can destroy hazardous wastes to more than 'six nines' destruction removal efficiency. Only limited environmental data are currently available, and considerable efforts are still necessary to characterize the environmental effects from plasma-arc application. In evaluating the costs of the process it is necessary to consider the following factors: (1) it is a pyrolysis process, and does not need the energy to heat excess air required by conventional incinerators; (2) a smaller capacity of downstream cleanup systems is needed because no excess air is involved; and (3) the energy source is electricity which is more expensive compared with the oil used to fire incinerators. (See also W91-00900) (White-Reimer-PTT)
W91-00940

MOBILE THERMAL TREATMENT SYSTEMS.
IT Corp., Knoxville, TN.
S. G. DeCicco, and W. L. Troxler.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.179-8.194, 4 fig, 4 tab, 19 ref.

Descriptors: *Hazardous waste treatment, *Heat treatment, *Incineration, *On-site waste disposal,

*Waste treatment, Economic aspects, Hazardous materials, Treatment criteria, Waste disposal.

On-site treatment by a mobile thermal treatment system may be considered for a site which contains several thousand tons of materials which are considered toxic, reactive, or not readily amenable to treatment by other technologies. Examples of such wastes include materials contaminated with PCBs, dioxins, chlorinated phenols, pesticides, herbicides, and explosives and propellants. Truly mobile systems are generally truck-mounted, have minimal field-erection and installation requirements, and can be relatively easily mobilized and demobilized. The primary factors determining the throughput or processing capacity of a thermal treatment system are the waste characteristics, the operating temperature, excess-air requirements, and heat-transfer considerations. Upper processing limits are typically set by either gas-handling or heat-transfer considerations, with the controlling criteria dependent upon the type of equipment and the type of waste being processed. Commercial systems available include: rotary kiln with a secondary combustion chamber; indirectly heated thermal desorber with a secondary combustion chamber; fluidized bed; infrared furnace; cascading-bed reactor; and plasma arc. Treatment costs are a function of waste type, waste quantity, processing rate, and capital costs. (See also W91-00900) (White-Reimer-PTT)
W91-00941

CATALYTIC INCINERATION.
Four Nines, Inc., Plymouth Meeting, PA.
Y. H. Kiang.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 8.195-8.201, 2 fig.

Descriptors: *Catalysis, *Catalytic incineration, *Hazardous waste treatment, *Incineration, *Waste treatment, Liquid wastes, Pollution control, Waste disposal.

The primary application of catalytic incineration systems is the oxidation of organic compounds in gaseous streams. Liquid wastes can also be treated in a catalytic incineration system. However, application of catalytic incineration to liquid-waste disposal is rather limited. Catalytic incineration systems cannot be used for solid-waste disposal. The poison and masking of catalysts are a major concern in the application of catalytic incineration and must be studied before a catalytic system is selected. The important design parameters for a catalytic incinerator include the superficial-gas velocity, the catalysts used, the geometric support of catalysts (i.e. the form of the catalyst element), the depth of the catalyst bed, waste type and composition, and the incineration temperature. Air-pollution control systems can be used so that air emissions from a well-run catalytic incinerator will not affect the environment; however, the wastewater from the air-pollution system may require further treatment. The residues discharged from a catalytic incineration system are from spent catalysts, and can be landfilled or sold for precious-metal recovery. (See also W91-00900) (White-Reimer-PTT)
W91-00942

AEROBIC PROCESSES.
Notre Dame Univ., IN.
R. L. Irvine, and P. A. Wilderer.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 9.3-9.18, 3 fig.

Descriptors: *Aerobic treatment, *Biological treatment, *Hazardous waste treatment, *Waste treatment, *Wastewater treatment, Case studies, Design criteria, Organic wastes, Toxicity.

An overview of aerobic biological treatment for hazardous wastes is presented. Most 'hazardous organics' can be treated biologically provided that the proper organism distribution can be established. A substance that is hazardous for one group of organisms may be a valuable food source for another group. It is only by viewing biological treatment systems as a dynamic population of microbes whose composition is subject to various selection pressures that proper systems can be designed, maintained, and corrected when problems arise. The wastes subject to aerobic biological treatment are characterized by high organic content, low and high pH, elevated salt levels, presence of heavy metals, and presence of hazardous organics. Factors that affect the system are extent of biodegradability, applicability of conventional technology, effects of toxic and nontoxic inorganics, effects of toxic and nontoxic organics, load variations, nutrient requirements, pH, oxygen supply, and temperature. In designing an aerobic biological treatment process for leachates and highly contaminated wastewaters it is necessary to consider biological principles, general flow diagrams, and bioreactor flow diagrams. Contaminated soils can be excavated and placed in bioreactors and then mixed and aerated. In general, the biological principles for liquids are directly applicable to soils. Case studies conducted at DuPont's Chambers Works site at Deepwater, New Jersey and at CECOS International's hazardous waste disposal in Niagara Falls, New York demonstrated the feasibility of these systems for treating hazardous wastes. However, a program of quality control and chemical equalization on the entering streams must be established so that potentially harmful or persistent substances are excluded; and temperature variations, especially during the transition to cold weather conditions, must be controlled. (See also W91-00900) (White-Reimer-PTT)
W91-00943

ANAEROBIC DIGESTION.
Remediation Technologies, Inc., Kent, WA.
M. F. Torpy.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 9.19-9.28, 3 tab, 35 ref.

Descriptors: *Anaerobic digestion, *Hazardous waste treatment, *Waste treatment, *Wastewater treatment, Anaerobic filters, Anaerobic-sludge blanket process, Biological treatment, Methane, Methanogenesis, Organic wastes, Toxicity.

Anaerobic digestion is a sequential, biologically destructive process in which hydrocarbons are converted, in the absence of free oxygen, from complex to simpler molecules, and ultimately to carbon dioxide and methane. Hazardous waste streams often consist of hydrocarbons in high concentrations of chemical oxygen demand (COD). The treatability of the waste depends on the susceptibility of the hydrocarbon content to anaerobic biological degradation, and also on the ability of the organisms to resist detrimental effects of biologically recalcitrant, and toxic organic and inorganic chemicals. The metabolic interactions between the various groups of organisms are essential to the successful and complete mineralization of the organic molecules. Various parameters are monitored to maintain efficient operating conditions within the reactor. They relate to the influent quality, the biological activity of the reactor, and the quality of the reactor environment. The biochemical methane potential (BMP) assay is a conventional test used to evaluate the anaerobic treatability of the waste. The two major reactor types are the anaerobic filter in which the bacteria attach as a thin biofilm to the surface within the reactor, and the upflow anaerobic-sludge blanket which contains highly settleable sludge particles. Other reactor types that may be appropriate for particular wastes are the two-stage reactor, lagoon with full-length biomass contact, and hybrid. (See also W91-00900) (White-Reimer-PTT)
W91-00944

LAND TREATMENT OF HAZARDOUS WASTES.
Woodward-Clyde Consultants, Santa Ana, CA.
T. Phung.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 9.41-9.51, 1 tab, 11 ref.

Descriptors: *Hazardous waste disposal, *Land disposal, *Landfills, *Waste disposal, Biological treatment, Degradation, Environmental effects, Microorganisms, Soil characteristics.

Land treatment is a waste treatment and disposal process whereby a waste is mixed with or incorporated into the surface soil and is degraded, transformed, or immobilized through proper management. If properly managed, soil may serve as an effective treatment and disposal sink for many hazardous wastes. In land treatment, the organic fraction must be biodegradable at reasonable rates so as to minimize environmental problems associated with migration of hazardous-waste constituents. Some principal factors affecting the operation of the system are waste characteristics, soil characteristics, microorganisms, and waste degradation which is affected by soil pH, moisture content, temperature, nutrients and other factors. Considerations in the operation and design of a system are area and facility layout, equipment, water management, soil erosion, waste application, facility inspection and record keeping, site monitoring, and closure and postclosure. Predicting the environmental effects of soil-waste interactions is difficult because of the inherent variability of the waste and of the treatment medium (soil), and the unpredictable influence of climatic variability. Without a detailed analysis of land treatment components and a sound design and management plan, adverse environmental effects can result from land treatment practices. Harmful effects associated with land treatment of hazardous wastes can be of a biological, chemical, physical mechanical, or psychological nature. Hazards associated with field operations include those linked to equipment operations, fire and explosion, dust and aerosols, and odor problems. (See also W91-00900) (White-Reimer-PTT)
W91-00945

BIODEGRADATION OF ENVIRONMENTAL POLLUTANTS.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
P. R. Sferra.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 9.53-9.60, 27 ref.

Descriptors: *Biodegradation, *Biological treatment, *Hazardous waste disposal, *Waste treatment, *Wastewater treatment, Aerobic treatment, Anaerobic digestion, Detoxification, Genetic engineering, Microbial degradation.

Among the methods considered for the destruction of hazardous and toxic wastes is the use of living organisms or their products to detoxify or destroy the polluting chemicals by means of a process known as biodegradation, In biodegradation there is the potential for low-cost, highly effective treatment with little or no consequential harm to the environment. The different biological processes or biotechnologies can be classified as being either conventional or emerging. Among the conventional systems are (1) aerobic treatments such as activated sludge, aerated lagoons, trickling filters, and rotating biological contactors; and (2) anaerobic treatments, of which there are three main types: anaerobic digestion, anaerobic contact, and anaerobic fixed-film. The search for useful biological agents to destroy hazardous wastes consists of an assortment of methodologies ranging from attempts to isolate pure strains from real-life contaminated situations to sophisticated genetic-engineering applications to produce a tailor-made organism capable of degrading a specific compound. There are two types of chemicals in the environment, xenobiotic and natural. When xenobiotic compounds are released into the environment they are subjected to the processes of adsorption, sedimentation, and chemical reactions including biotransformation and photolysis. Microorganisms adapt to degrade new synthetic compounds either by utilizing catabolic enzymes they already possess or by acquiring new metabolic pathways. In pollution control the need is for the organism that can process the xenobiotic. Among the innovative or emerging methods to develop microorganisms specifically suited to degrade hazardous wastes are plasmid-assisted molecular breeding, gene-engineering, and enhancement of indigenous microorganisms. Potential risks of this approach are described as 'low probability of high-consequence risks'; that is, while there is only a small possibility

that damage could occur, the damage that could occur is great. (See also W91-00900) (White-Reimer-PTT)
W91-00946

ENZYME SYSTEM AND RELATED REACTIVE SPECIES.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
J. A. Glaser.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 9.61-9.73, 3 fig, 6 tab, 31 ref.

Descriptors: *Detoxification, *Enzymes, *Hazardous waste disposal, *Waste treatment, Hydrolases, Inhibition, Kinetics, Oxidoreductases.

The use of enzymes as a means to detoxify hazardous-waste constituents is a new and growing research area. The reactions of detoxifying enzymes are not limited to intracellular conditions but have been demonstrated through the use of immobilized enzyme extracts on several liquid waste streams. In order to evaluate the ability of enzyme systems to accomplish the detoxification transformations on the substrate molecule it is necessary to determine the rate of reaction associated with the transformation and any other rates that may be limiting. The action of enzymes is limited by two basic considerations. The physical constraints of the active site within the enzyme molecule and the attendant kinetic expression relating the rate of disappearance of substrate to time result in a series of kinetic limitations referred to as enzyme inhibition that are integral to an understanding of enzyme use. A subtle limitation is the resistance of the enzyme to destruction by outside agents. Enzymes used in the process include oxidoreductases and hydrolases. Common applications of cell-free enzyme extracts have generally involved some sort of immobilization. The enzyme can be chemically bound to a support and is then assembled into a bed through which a solution containing the substrate is passed. Although there is information detailing the expenses of industrial enzyme scaleup, very little cost-comparison information is available for this type of enzymatic application. (See also W91-00900) (White-Reimer-PTT)
W91-00947

HAZARDOUS-WASTE LANDFILL CONSTRUCTION: THE STATE OF THE ART.
SCS Engineers, Inc., Long Beach, CA.
For primary bibliographic entry see Field 5E.
W91-00948

SUBSURFACE INJECTION OF LIQUID HAZARDOUS WASTES.
Missouri Univ.-Rolla. School of Mines and Metallurgy.
For primary bibliographic entry see Field 5E.
W91-00950

SURFACE IMPOUNDMENTS.
Brown (K.W.) and Associates, Inc., College Station, TX.
For primary bibliographic entry see Field 5E.
W91-00951

5E. Ultimate Disposal Of Wastes

IMPLICATIONS OF ENVIRONMENTAL PROGRAM PLANNING FOR SITING A NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN, NEVADA, USA.
Department of Energy, Carson City, NV. Nevada Nuclear Waste Project Office.
C. R. Malone.
Environmental Management EMNGDC, Vol. 14, No. 1, p 25-32, January/February 1990. 2 tab, 28 ref.

Descriptors: *Environmental effects, *Environmental policy, *Nevada, *Radioactive waste disposal, *Underground waste disposal, Environmental management, Environmental protection, Geological surveys, Hydrologic aspects, Site selection.

The US Department of Energy (DOE) plans to conduct site characterization studies at Yucca Mountain, Nevada, to determine if the location is a suitable site for a nuclear waste repository. In lieu of traditional environmental review in accordance with the National Environmental Policy Act of 1969, the DOE is relying on an environmental assessment (EA) mandated by the Nuclear Waste Policy Act of 1982 as the cornerstone of its environmental program for the Yucca Mountain Project. Because of statutory restrictions, the EA is not based on comprehensive baseline information. Neither does it address fundamentals of environmental analysis such as ecological integrity and assessment of cumulative impacts. Consequently, the present environmental program for Yucca Mountain reflects decisions made without complete information and integrated environmental review. The shortcomings of the program risk compromising the natural integrity of Yucca Mountain and invalidating future assessment of the ability of a nuclear waste repository located at the site to protect the environment. Significant improvements are needed in the repository siting program before it can serve as a model of how society can evaluate the long term environmental consequences of advanced technologies. (Author's abstract)
W91-00026

GEOLOGIC AND HYDROLOGIC ISSUES RELATED TO SITING A REPOSITORY FOR HIGH-LEVEL NUCLEAR WASTE AT YUCCA MOUNTAIN, NEVADA, U.S.A.
Department of Energy, Carson City, NV. Nevada Nuclear Waste Project Office.
C. R. Malone.
Journal of Environmental Management JEVMAW, Vol. 30, No. 4, p 381-396, June 1990. 80 ref.

Descriptors: *Geohydrology, *Nevada, *Radioactive wastes, *Site selection, *Underground waste disposal, Environmental policy, Seismic properties, Tectonics, Waste management, Yucca Mountain.

After three decades, policy in the United States for managing high-level nuclear wastes has settled on disposal of the wastes in deep geologic repositories. The site selection program for this endeavor currently is focused on a single site at Yucca Mountain, Nevada. A number of important and unresolved issues have arisen with respect to the geologic and hydrologic suitability of Yucca Mountain for isolating nuclear wastes. These include concerns such as the potential for future tectonic and volcanic events to occur at the site and the unknown nature of the unsaturated zone at Yucca Mountain. This paper reviews these issues and concludes that much of the information used to support nomination of the Yucca Mountain site for characterization is incomplete and equivocal. Moreover, reliable methods and techniques do not always exist for resolving the uncertainties with deterministic methods based on empirical data. (Author's abstract)
W91-00030

AUDITING THE QUALITY OF EFFLUENT DISCHARGES.
Anglian Water Authority, Peterborough (England).
For primary bibliographic entry see Field 5G.
W91-00127

ESTIMATION OF PHOSPHORUS FROM THE NIAGARA RIVER TO LAKE ONTARIO.
Waterloo Univ. (Ontario).
M. E. Thompson, and A. H. El-Shaarawi.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 323-330, November 1989. 1 fig, 4 tab, 4 ref.

Descriptors: *Canada, *Lake Ontario, *Niagara River, *Path of pollutants, *Phosphorus, *Pollution load, *Statistical studies, Data interpretation, Wastewater disposal.

A predictive or model based approach for making inferences about the loading of a contaminant from a point source has been developed, using a statistical approach. The model has been used to estimate the total phosphorus (TP) loading from the Niagara River to Lake Ontario for the years 1967 to 1982. Information about explanatory variables and/or autodependence among successive observations can be easily included in the model; this allows more accurate inferences to be made. Typically for this kind of investigation, daily values for river flow are known while values for the concentration of phosphorus are known for some but not all days. The model utilized matrix notation and a Gaussian distribution of phosphorus concentrations to predict the phosphorus loading on days with no TP measurement. Results of the application to the Niagara River show that a major decrease in TP loading has occurred during the study period. (Tappert-PTT)
W91-00133

SLUDGE DISPOSAL, DALLAS STYLE.
Lockwood, Andrews and Newman, Inc., Dallas, TX.
J. L. Moseley, L. N. Patterson, and R. B. Sieger.
Civil Engineering (ASCE) CEWRA9, Vol. 60, No. 8, p 50-52, August 1990. 3 fig.

Descriptors: *Sludge disposal, *Sludge drying, *Texas, *Wastewater treatment, Coagulation, Composting, Environmental protection, Hydraulic engineering, Land disposal, Liquid sludge, Monitoring.

The efficiency of wastewater treatment directly affects the overall water quality of rivers, lakes, and streams. Dallas (Texas) Water Utilities treats approximately 200 million gallons per day from individuals, businesses, and surrounding communities. The two treatment facilities use natural processes to remove the solids and sludge. In the past, the liquid sludge from the two facilities was combined and then injected into dedicated land disposal fields. However, problems (weather-dependency, acreage requirements) with this method caused the city council to adopt a sludge master plan. It required comparison of risks, and consideration of environmental issues, community acceptance, regulatory constraints, operational concerns, administration interests, and energy consumption. A facility was designed to meet requirements until 2010. Innovations that helped meet the goals of the master plan included: (1) environmental protection of the surrounding environment through a soil slurry cutoff wall; (2) soil and groundwater monitoring; (3) flexibility in ultimate sludge disposal through sludge monofill, dedicated-land disposal, or eventual composting; (4) transfer of dewatered sludge cake through pipeline to the sludge monofill using high pressure hydraulic piston pumps; (5) pretesting of dewatering equipment prior to acceptance to assure that guaranteed parameters were met; (6) a system of sludge-soil mixing and processing prior to disposal in monofill; (7) a privatization request for proposal enables the monofill to be operated by contract services; and (8) belt filter presses which dewater the sludge using polymer as a coagulant. The project is one of the largest engineering assignments in the history of Dallas. (Fish-PTT)
W91-00143

STREAMFLOW SIMULATION USING DETERMINISTIC MODEL.
Dames and Moore, Park Ridge, IL.
For primary bibliographic entry see Field 2E.
W91-00174

GEOHYDROLOGIC ASPECTS FOR SITING AND DESIGN OF LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL.
M. S. Bedinger.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Survey Circular 1034. 36p, 28 fig, 1 tab, 76 ref.

Descriptors: *Geohydrology, *Hazardous waste disposal, *Radioactive waste disposal, *Site selection, *Underground waste disposal, Aeration zone, Design criteria, Groundwater movement, Hydrologic properties, Waste containment.

The objective for siting and design of low-level radioactive-waste repository sites is to isolate the waste from the biosphere until the waste no longer poses an unacceptable hazard as a result of radioactive decay. Low-level radioactive waste commonly is isolated at shallow depths with various engineered features to stabilize the waste and to reduce its dissolution and transport by groundwater. The unsaturated zone generally is preferred for isolating the waste. Low-level radioactive waste may need to be isolated for 300 to 500 years. Maintenance and monitoring of the repository site are required by federal regulations for only the first 100 years. Therefore, geohydrology of the repository site needs to provide natural isolation of the waste for the hazardous period following maintenance of the site. Studies at existing commercial and federal waste-disposal sites provide information on the problems encountered and the basis for establishing siting guidelines for improved isolation of radioactive waste, engineering design of repository structures, and surveillance needs to assess the effectiveness of the repositories and to provide early warning of problems that may require remedial action. Climate directly affects the hydrology of a site and probably is the most important single factor that affects the suitability of a site for shallow-land burial of low-level radioactive waste. Humid and subhumid regions are not well suited for shallow isolation of low-level radioactive waste in the unsaturated zone; arid regions with zero to small infiltration from precipitation, great depths to the water table, and long flow paths to natural discharge areas are naturally well suited to isolation of the waste. The guiding rationale is to minimize contact of water with the waste and to minimize transport of waste from the repository. The hydrology of a flow system containing a repository is greatly affected by the engineering of the repository site. Prediction of the performance of the repository is a complex problem, hampered by problems of characterizing the natural and manmade features of the flow system and by the limitation of models to predict flow and geochemical processes in the saturated and unsaturated zones. Disposal in low-permeability unfractured clays in the saturated zone may be feasible where the radionuclide transport is controlled by diffusion rather than advection. (Author's abstract)
W91-00347

SUBSURFACE TRANSPORT OF INORGANIC AND ORGANIC SOLUTES FROM EXPERIMENTAL ROAD SPREADING OF OIL-FIELD BRINE.
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
For primary bibliographic entry see Field 5B.
W91-00365

GROUND WATER RECHARGE AND POLLUTION POTENTIAL OF DRY WELLS IN PIMA COUNTY, ARIZONA.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5B.
W91-00367

TRANSPORT OF LOW-CONCENTRATION CONTAMINANTS IN SATURATED EARTHEN BARRIERS.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
Y. B. Acar, and L. Haider.
Journal of Geotechnical Engineering (ASCE) JGENDZ, Vol. 116, No. 7, p 1031-1052, July 1990. 12 fig, 6 tab, 38 ref.

Descriptors: *Landfills, *Liners, *Mathematical models, *Model studies, *Solute transport, *Waste disposal, *Water pollution prevention, Chlorinated hydrocarbons, Earthworks, Groundwater movement, Mathematical analysis.

The need to protect the groundwater against potential contamination has led to the use of containment barrier technology for shallow land disposal facilities under construction, as well as for existing unengineered facilities and/or sites. The objectives of engineering these barriers were to ascertain their structural integrity and to minimize the potential dangers associated with migration of the leachate generated with infiltrating water. Design guidelines are presented for fine-grained earthen barriers based upon the fundamental parameters affecting containment transport, providing a methodology for estimating the time required for the contaminant to breakthrough, and determining the thickness of the earthen barrier for a specified breakthrough concentration and design life. Laboratory tests indicated that a one-dimensional advective-dispersive transport model for reactive solutes provided reasonable estimates of the breakthrough of low-concentration organic contaminants in saturated fine-grained earthen barriers. Based upon this transport model, a design/analysis methodology and respective guidelines were developed for earthen barriers used in waste disposal applications. The fundamental parameters affecting the design are the seepage velocity, retardation factor, and chemical diffusion of the contaminant in the pore fluid. Transport of low-concentration trichloroethylene at a selected study site was selected for illustrating the procedure. (Author's abstract)
W91-00372

HERCULEAN LABORS TO CLEAN WASTEWATER.
Golob's Oil Pollution Bulletin, Cambridge, MA.
For primary bibliographic entry see Field 5D.
W91-00387

GAS-PHASE AND ACTIVATED CARBON MEDIATED THERMAL HYDROGENOLYSIS OF HALOGENATED ORGANICS.
Leiden Rijksuniversiteit (Netherlands). Gorlaeus Labs.
For primary bibliographic entry see Field 5D.
W91-00395

BIOREMEDIATION COMES OF AGE.
Bioscience Management, Inc., Bethlehem, PA.
For primary bibliographic entry see Field 5G.
W91-00400

WATER LEVELS IN PERIODICALLY MEASURED WELLS IN THE YUCCA MOUNTAIN AREA, NEVADA, 1988.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2F.
W91-00441

MACROFAUNA DISTRIBUTIONS AND SEDIMENT ANALYSES FROM THE BRUNSWICK, GEORGIA OCEAN DREDGED MATERIAL DISPOSAL SITE AND ENVIRONS.
Georgia Univ., Savannah. Marine Extension Service.
D. M. Gillespie, J. L. Harding, R. A. Culp, J. E. Noakes, and A. L. Edwards.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-207385/AS. Price codes: A06 in paper copy, A01 in microfiche. Technical Report Series Number 89-1, 1989. 103p, 6 fig, 20 tab, 30 ref.

Descriptors: *Dredging wastes, *Georgia, *Marine animals, *Sediment analysis, *Spoil disposal, *Water pollution effects, *Water pollution sources, Biological samples, Distribution patterns, Environmental effects, Ocean dumping, Statistical analysis.

Sediment samples were obtained from the proposed Ocean Dredged Material Disposal Site and from nearby areas and subjected to chemical and biological analyses. Water samples and trawl tows were also taken over and near the disposal site. Sediment samples were analyzed for grain size distribution, human debris, total organic carbon, oil and grease, high molecular weight hydrocarbons, pesticides, halogenated hydrocarbons, and heavy metals. Trawl macrofauna were also subsampled and analyzed for tissue organics and metals. Sediment was sieved to 0.5 mm, and the macrofauna preserved, identified, and counted. Date were statistically analyzed for possible treatment effects related to the use of the site for disposal of dredged material. Statistical results are presented, along with tables of physical and chemical data. Macrofauna densities are tabulated by station, relative to position over or near the disposal site. No consistent pattern of treatment effect could be discerned from analysis of the data using our sampling regime and analytical techniques. Although ocean dredge spoil dumping undoubtedly disturbs the environment, this study suggests that effects are transient in this area. (Author's abstract)
W91-00444

SUPERFUND RECORD OF DECISION: VELSICOL CHEMICAL CORPORATION, IL.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-00445

FIELD EVALUATION OF THE EFFECT OF CHLORINATED TREATED SEWAGE ON SETTLEMENT OF OYSTERS (CRASSOSTREA VIRGINICA GMELIN) AND BARNACLES (BALANUS SP).
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5C.
W91-00511

INACTIVATION OF ENTERIC VIRUSES IN CHLORINATED WASTEWATER SPRAYED ON VEGETABLES.
Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5D.
W91-00548

USERS MANUAL FOR THE SLUDGEMAN MODEL FOR THE GROUNDWATER PATHWAY IN THE MONOFILLING OF SEWAGE SLUDGE.
ICF Technology, Inc., Fairfax, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-149322. Price codes: A11 in paper copy, A01 in microfiche. Report No. EPA/SW/DK-89/023a, September 1988. 224p, 27 append. EPA Contract 68-03-3534.

Descriptors: *Computer models, *Groundwater pollution, *Model studies, *Path of pollutants, *SLUDGEMAN model, *Sludge disposal, *Waste disposal, *Water pollution sources, Computer programs, Heavy metals, Landfills, Leaching, Manuals, Municipal wastewater, Risk assessment.

One of the major options actively being considered for the disposal of municipal sewage sludges is landfilling. This option poses a risk to human health and the environment as a result of the presence of heavy metals and other toxic substances in the sludge. In order to reduce the risk to acceptable levels, the EPA has undertaken a regulatory program based on risk management and risk assessment. A set of computer programs called SLUDGEMAN was developed which quantifies the risk associated with landfill options. SLUDGEMAN calculates a reasonable 'worst case' level of human exposure to chemicals leaching from a landfill and being carried by the atmosphere. Exposure levels can be compared to health criteria to determine if they are likely to cause unacceptable impacts. This document is the users manual for the SLUDGEMAN computer programs. (Lantz-PTT)
W91-00575

CONTAMINANT DISSOLUTION AND DIFFUSIONAL TRANSPORT WITH A STATIONARY PRECIPITATION FRONT.
California Univ., Berkeley. Dept. of Nuclear Engineering.
W. B. Light, P. L. Chambre, T. H. Pigford, and

W. W. L. Lee.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1681-1685, July 1990. 3 fig, 10 ref. U.S. Department of Energy Contract DE-AC03-76SF00096.

Descriptors: *Groundwater pollution, *Path of pollutants, *Radioactive waste disposal, *Underground waste disposal, *Waste disposal, *Waste dumps, *Water pollution sources, Diffusion, Dissolution, Mass transport, Mathematical analysis, Numerical analysis, Solubility.

Waste material in a geologic repository will eventually dissolve and migrate away, degrade by chemical reaction or radioactive decay, or become part of the basic rock material. For many waste components these processes will be limited by the dissolution rate of the waste matrix. The precipitation may be due to local geochemical changes such as changes in temperature, pH, or redox potential, caused by nearby geologic features or the waste itself. The effect of contaminant precipitation caused by a drop in the solubility at some specified location away from the waste is analyzed. Transport is by diffusion only; advection is neglected. Analytical solutions are presented for the contaminant concentration in groundwater and the mass transfer rate as functions of space and time for regions on both sides of the precipitation front. At early times the mass transfer rate at the waste surface is controlled by the solid-liquid reaction rate; at later times extending to steady state, the mass transfer rate depends on the location of the precipitation front and on the solubility ratio. Numerical illustrations are made applicable to nuclear waste in a geologic repository. If the U.S. Nuclear Regulatory Commission's (1983) release rate requirement for the engineered barrier system is to be met at the waste package/rock interface, precipitation, which can increase the mass transport rate near the waste package, must be considered. (MacKeen-PTT)
W91-00612

REMARKS ON THE ZOOPLANKTON POPULATION STRUCTURE NEAR WASTEWATER OUTFALLS ON THE ROMANIAN SHORE OF THE BLACK SEA (REMARQUES SUR LA STRUCTURATION DES POPULATIONS ZOOPLANCTONIQUES DANS LES ZONES DES EMISSAIRES D'EAUX USEES DU LITTORAL ROUMAIN DE LA MER NOIRE).
Institutul Roman de Cercetari Marine, Constanta (Romania).
For primary bibliographic entry see Field 5C.
W91-00711

SLUDGE MANAGEMENT SYSTEMS.
Montgomery (James M.) Consulting Engineers, Inc., Pasadena, CA.
For primary bibliographic entry see Field 5D.
W91-00771

STANDARD HANDBOOK OF HAZARDOUS WASTE TREATMENT AND DISPOSAL.
For primary bibliographic entry see Field 5D.
W91-00900

HAZARDOUS-WASTE TREATMENT COMES OF AGE.
Hazardous Waste Treatment Council, Washington, DC.
For primary bibliographic entry see Field 5G.
W91-00901

SUMMARY OF RESOURCE CONSERVATION AND RECOVERY ACT LEGISLATION AND REGULATION.
Tufts Univ., Medford, MA. Center for Environmental Management.
For primary bibliographic entry see Field 6E.
W91-00902

QUANTITIES AND SOURCES OF HAZARDOUS WASTES.
Westat Research, Inc., Rockville, MD.
S. K. Dietz, and M. E. Burns.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 2.3-2.19, 8 fig, 2 tab.

Descriptors: *Environmental protection, *Hazardous materials, *Hazardous wastes, *Regulations, *Resource Conservation and Recovery Act, Data acquisition, Hazardous waste disposal.

Data collected pertaining primarily to hazardous wastes and hazardous-waste handlers subject to regulation under Subtitle C of the Resource Conservation and Recovery Act (RCRA) are presented. There are five main information sources for this data. The purpose of the Hazardous Waste Data Management System is regulatory rather than planning or research. It contains a record for every facility in the U.S. that has applied for an EPA permit to treat, store, or dispose of hazardous wastes regulated under RCRA. The EPA National Survey of Hazardous Waste provided the first statistically reliable estimate of (1) the numbers of facilities generating, treating, storing, and disposing of hazardous waste, (2) the types of processes used, and (3) the characteristics of such facilities. A follow-up survey on hazardous wastes was conducted in 1986 at the request of the EPA. In addition, the EPA is conducting a biennial census of hazardous-waste treatment, storage, and disposal facilities. Information on hazardous waste generation presented includes: (1) the total number of generators; (2) the number of generators by EPA region; (3) the number of generators by industry type; (4) the number of generators shipping waste off-site; and (5) the quantity of hazardous waste generated. The quantity of RCRA-regulated hazardous waste generated at any point in time is essentially affected by two factors: (1) the specific nature and scope of the RCRA hazardous-waste regulatory program at that time; and (2) the nature of the industrial and other activities that actually result in hazardous by-products. (See also W91-00900) (White-Reimer-PTT)
W91-00905

HAZARDOUS-WASTE MANAGEMENT CAPACITY.
MITRE Corp., McLean, VA.
G. A. Vogel.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 2.21-2.31, 4 tab, 13 ref.

Descriptors: *Hazardous materials, *Hazardous waste disposal, *Regulations, *Resource Conservation and Recovery Act, Environmental protection, Permits, Storage capacity.

The capacity of hazardous-waste management units that are operating within the Resource Conservation and Recovery Act (RCRA) regulatory program under interim status on a final permit is emphasized. Capacity data sources include: (1) EPA sources such as permit applications and surveys; and (2) commercial directories and services. Hazardous wastes may be stored in tanks, surface impoundments, containers, or piles. It is estimated that there are 5,455 storage tanks in the RCRA regulatory program, with a total design capacity of 757 million liters. The annual waste-management capacity may be up to 25 time greater than the design capacity. Hazardous wastes are treated in tanks, surface impoundments, incinerators, and other thermal devices such as cement kilns and boilers. It is estimated that there are 3,569 treatment tanks in the RCRA regulatory program with a total design capacity of 90 million liters. The annual waste-treatment capacity of these tanks may be up to 365 times greater than the design capacity. Hazardous wastes can be disposed in landfills, land treatment facilities, injection wells, and surface impoundments. It was estimated in 1984 that there were approximately 130 commercial waste-management facilities in the United States under RCRA. At the beginning of 1985, after two years of full RCRA program operation, approximately 7% of the 4,900 hazardous-waste storage, incineration, and land disposal facilities needing RCRA permits by EPA had been issued permits. Because of the complexity of the RCRA permitting process and limited EPA staff resources, the number of RCRA permits issued is not expected to increase rapidly, despite the regulatory deadlines. (See also W91-00900) (White-Reimer-PTT)
W91-00906

SITING OF HAZARDOUS-WASTE FACILITIES.
North Carolina Univ. at Chapel Hill. Inst. for Environmental Studies.
R. N. L. Andrews, and F. M. Lynn.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 3.3-3.16, 5 fig, 20 ref.

Descriptors: *Hazardous waste disposal, *Hazardous wastes, *Hazardous-waste facilities, *Site selection, Permits, Public participation, Public relations, Regulations.

The siting of hazardous-waste facilities requires a synthesis of two distinct selection procedures: a technical screening process based upon engineering, environmental, and economic suitability; and a public-approval process based upon legality and political acceptability. A technical screening process is used to identify sites that are potentially suitable for a hazardous-waste facility. There are three sets of criteria: characteristics of the facility, characteristics of the site, and economic and legal feasibility. Within the range of technically feasible sites, hazardous-waste facility siting requires at least two forms of regulatory approval: facility approval by a federal or federally approved state agency, and site approval by local or state government. Site approval for hazardous-waste facilities requires not only technical suitability and permit approval, but acceptability of the facility to the host community. At a minimum, public acceptance normally requires two steps of the sponsors beyond technical analysis and state permit approval: substantive information concerning potential impacts, and willingness to engage in an open process of communication and negotiation with the host community. The cornerstone of a successful siting process is early, open, and ongoing communication among all affected parties. The main building blocks of this process include joint fact finding, a community review committee, independent technical assessment, and a fair and open process of negotiation with the host community. (See also W91-00900) (White-Reimer-PTT)
W91-00907

HEALTH EFFECTS OF HAZARDOUS WASTE.
South Carolina State Dept. of Health and Environmental Control, Columbia. Bureau of Preventive Health Services.
For primary bibliographic entry see Field 5C.
W91-00908

ENVIRONMENTAL RISK-ASSESSMENT AND AUDIT PRINCIPLES.
Environmental Strategies Corp., Vienna, VA.
L. M. Miller, and D. E. Gladstone.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 3.29-3.38, 7 ref.

Descriptors: *Hazard assessment, *Legal aspects, *Liability, *Risk assessment, *Water law, Economic aspects, Environmental policy, Resource Conservation and Recovery Act.

Environmental-risk assessment evaluates the potential for liabilities, impairment, or claims resulting from environmental pollution arising from a facility. A useful procedure to evaluate regulatory compliance is an environmental audit, a procedure that determines whether a facility meets appropriate regulatory and nonregulatory standards. For a company with multiple locations, the first step in the risk assessment process involves selection of sites to be assessed, taking into account corporate resources and the objective of the risk-assessment program. The purpose of an environmental audit is to provide corporate management with the assurance that their facilities will not be the source of liabilities for the corporation or its officers and directors. Environmental assessments and audits

can be powerful tools to unite corporate and facility personnel in the struggle against the accrual of environmental liabilities. Since the Resource Conservation and Recovery Act (RCRA) requires certain hazardous-waste facilities to demonstrate financial responsibility for bodily injury and property damage to third parties, these facilities must show evidence of liability coverage for sudden and accidental occurrences at minimum limits of $2 million. Because companies are self-assuming a large portion of their pollution exposures today, the incentive to identify pollution liability has increased greatly. (See also W91-00900) (White-Reimer-PTT)
W91-00909

CASE STUDY OF A SUCCESSFUL FACILITY SITING.
E. E. Kupchanko.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 3.39-3.49, 1 fig, 8 ref.

Descriptors: *Canada, *Hazardous materials, *Hazardous waste disposal, *Public policy, *Site selection, Alberta, Case studies, Project planning, Public participation.

A case study is described in which a private firm proposed to build a disposal plant capable of handling the wastes in western Canada. Over a period of 16 months, the hazardous-waste issue was defined through two bodies: the Hazardous Waste Committee and the Environment Council of Alberta. The implementation structure consisted of two bodies, the Hazardous Waste Team and the Task Force, which were to work closely together. The criteria for site selection were based on environmental and social acceptability. The technical approach to locating a site was based upon criteria by which environmentally unsuitable areas in the province could be eliminated from further investigation, a process known as constraint mapping. The most desirable land parcel would exhibit low capabilities for all land-use possibilities. The experience of the Rural Education and Development Association was utilized for the field program. This organization was deeply involved in public education in rural Alberta. The principal policy in the public-involvement program was that environmental acceptability would be the main criterion for selection and that the siting criteria would be open to public scrutiny. The government would reserve the overall right of final selection. The technique required to communicate a volatile issue requires a well-defined plan with clearly stated objectives. The communications program was based on two distinct strategies: one concerned media relationships, and the other involved the type of material distributed to the public. On March 12, 1984, the Minister of the Environment announced that an area 20 k northeast of Swan Hills was to be the site for the Alberta hazardous-waste facility, making it the only community in North America that had agreed to host a facility in their backyards in the preceding six years. (See also W91-00900) (White-Reimer-PTT)
W91-00910

MINING WASTES.
PEI Associates, Inc., Cincinnati, OH.
R. L. Hoye, and S. J. Hubbard.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 4.47-4.51, 7 ref.

Descriptors: *Mine wastes, *Solid wastes, *Waste disposal, Acid mine drainage, Cyanide, Heavy metals, Pyrite, Regulations.

The U.S. mining industry has generated up to 2 trillion kg of solid waste in a year and accounts for about 40% of the total solid waste generated annually in the United States. The EPA has estimated that about 31 trillion kg of mine waste and 13 trillion kg of tailings were accumulated between 1910 and 1981. Virtually all mine wastes are disposed of on site. In the early 1980's the EPA sponsored waste-characterization studies involving waste sampling at 86 mines in 22 states. Mining wastes contain, with the exception of the product recovered, all constituents present in the ore. The excavation and processing of this native material can expose constituents, such as pyrites, that have acid-forming potential. Heavy metals or potentially toxic elements, such as radionuclides, formerly contained in the ore matrix may become mobile in the environment once exposed. In addition, some process reagents, particularly cyanide, may be mixed with the waste. The EPA's Office of Research and Development and the Office of Solid Waste are actively acquiring and evaluating information germane to the mining-waste issue. (See also W91-00900) (White-Reimer-PTT)
W91-00911

HYDROLYSIS.
BDT, Inc., Clarence, NY.
For primary bibliographic entry see Field 5D.
W91-00915

SOLIDIFICATION AND STABILIZATION TECHNOLOGY.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5D.
W91-00929

LIQUID-INJECTION INCINERATORS.
Four Nines, Inc., Plymouth Meeting, PA.
For primary bibliographic entry see Field 5D.
W91-00930

ROTARY KILNS.
Boliden Allis, Inc., Milwaukee, WI. Minerals Systems Div.
For primary bibliographic entry see Field 5D.
W91-00931

FLUIDIZED-BED THERMAL OXIDATION.
Waste-Tech Services, Inc., Golden, CO.
For primary bibliographic entry see Field 5D.
W91-00932

CEMENT KILNS.
General Portland, Inc., Dallas, TX.
For primary bibliographic entry see Field 5D.
W91-00933

WET OXIDATION.
Zimpro, Inc., Rothschild, WI.
For primary bibliographic entry see Field 5D.
W91-00934

PYROLYSIS.
Midland-Ross Corp., Toledo, OH. Surface Div.
For primary bibliographic entry see Field 5D.
W91-00935

OCEANIC INCINERATION.
SITEX Environmental, Inc., Research Triangle Park, NC.
For primary bibliographic entry see Field 5D.
W91-00936

MOLTEN-GLASS PROCESSES.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5D.
W91-00937

DEEP-SHAFT WET-AIR OXIDATION.
Smith (J.M.) and Associates, Cincinnati, OH.
For primary bibliographic entry see Field 5D.
W91-00938

SUPERCRITICAL-WATER OXIDATION.
Modell Development Corp., Framingham, MA.
For primary bibliographic entry see Field 5D.
W91-00939

PLASMA SYSTEMS.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5D.
W91-00940

MOBILE THERMAL TREATMENT SYSTEMS.
IT Corp., Knoxville, TN.
For primary bibliographic entry see Field 5D.
W91-00941

CATALYTIC INCINERATION.
Four Nines, Inc., Plymouth Meeting, PA.
For primary bibliographic entry see Field 5D.
W91-00942

LAND TREATMENT OF HAZARDOUS WASTES.
Woodward-Clyde Consultants, Santa Ana, CA.
For primary bibliographic entry see Field 5D.
W91-00945

BIODEGRADATION OF ENVIRONMENTAL POLLUTANTS.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5D.
W91-00946

ENZYME SYSTEM AND RELATED REACTIVE SPECIES.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5D.
W91-00947

HAZARDOUS-WASTE LANDFILL CONSTRUCTION: THE STATE OF THE ART.
SCS Engineers, Inc., Long Beach, CA.
T. D. Wright, D. E. Ross, and L. Tagawa.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.3-10.23, 13 fig.

Descriptors: *Hazardous waste disposal, *Land disposal, *Landfills, *Waste disposal, Construction, Design criteria, Economic aspects, Operating policies.

An overview of landfill operation and construction is presented. Many but not all hazardous wastes can be disposed of on land in properly designed landfills. In most cases, hazardous wastes are initially deposited below grade in an existing natural or excavated depression or in a pit excavated for that purpose. Hazardous wastes delivered to a landfill site are placed in a manner such that only compatible wastes are disposed of together. To accomplish this objective wastes are placed either in separate areas or in individual control cells within a single, larger landfill. Environmental protection, including control of leachate emissions, gas emissions, and surface-water erosion and waste saturation, is an important aspect of site selection and construction for the hazardous-waste landfill. Pertinent landfill features that must be included in the design are access roads, cover soil, special working areas, buildings and structures, wash rack, landscaping, and monitoring facilities. Heavy equipment used for earth moving, waste handling, and compaction at hazardous-waste landfills includes rubber-tired loaders, vibratory compactors, forklifts and/ or barrel snatchers, scrapers, graders, and water trucks. Upon final closure of the landfill or completion of a cell, a final cover is applied. Postclosure maintenance and monitoring are also conducted. Design considerations include: facility life and size, topography, surface-water drainage, soils, geology, and groundwater. Costs are generally categorized into capital costs and operating costs. Capital costs include all initial expenses required prior to the start-up of landfilling operations. It is common to compute annual operating costs based on a cost per unit of waste received (e.g., dollars per ton). Operating costs for a landfill will vary significantly since local conditions and

labor rates are site-specific. (See also W91-00900) (White-Reimer-PTT)
W91-00948

SYNTHETIC LININGS.
Hovater Engineers, Laguna Hills, CA.
L. R. Hovater.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.25-10.40, 8 fig.

Descriptors: *Hazardous waste disposal, *Landfill linings, *Landfills, *Linings, *Waste disposal, Construction, Design criteria, Land disposal, Materials, Synthetic linings.

Synthetic linings have been used successfully for over 30 years, and most linings used today are of the synthetic type. Synthetic linings are generally known as flexible-membrane linings (FMLs), and are classified as varieties of plastic, rubber, and asphalt. Today plastic and rubber in thin sheets dominate the lining field for disposal of hazardous wastes on land. FMLs are susceptible to damage caused by chemical incompatibility with the contained hazardous waste. Evaluating and testing of the hazardous waste with potential FMLs are necessary to eliminate FMLs that are incompatible. FMLs are generally described by (1) their industry-accepted chemical name, which is usually indicative of their composition, and (2) their physical properties. Factors that contribute to the design criteria include: use; size and shape of the landfill or impoundment; depth; steepness of slope; supporting surface; open vs. closed facilities; accessibility; and life expectancy. Best results of installation are obtained by relying on state of the art design, materials, construction, and inspection. Critical aspects concerning installation are supporting surfaces, layout, field seams, anchors, seals, protective cover, geotextiles and drainage nets, and testing. There is no general rule of thumb pertaining to cost. Costs depend on the type of containment, the selection of FML, the quantity of FML, and the difficulty of installation. (See also W91-00900) (White-Reimer-PTT)
W91-00949

SUBSURFACE INJECTION OF LIQUID HAZARDOUS WASTES.
Missouri Univ.-Rolla. School of Mines and Metallurgy.
D. L. Warner.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.41-10.53, 1 fig, 4 tab, 11 ref.

Descriptors: *Hazardous waste disposal, *Injection wells, *Waste disposal, Design criteria, Monitoring, Regulations, Subsurface injection, Wastewater composition, Wastewater disposal.

An overview is presented of the extent of use of wastewater injection wells, and discussions of injection-well siting, of the evaluation of wastewater characteristics and preinjection treatment, of injection-well design and construction, of injection-system operation, of monitoring, and of regulation. Knowledge of the geologic and hydrologic characteristics of the subsurface environment at an injection-well site and in the surrounding region is fundamental to the evaluation of the suitability of the site for wastewater injection and to the design, construction, operation, and monitoring of injection wells. The characteristics of the untreated wastewater that must be considered in evaluating its suitability for disposal by subsurface injection include: volume, waste type, compatibility, and preinjection treatment. After site selection it is necessary to develop a well-design and construction program. The most common deficiency in well design has been inadequate provision for corrosion protection. The principal means of surveillance of wastewater injection that is presently practiced is monitoring at the injection well of the volume, flow rate, chemistry, and biology of the injected wastewater and of the injection and annulus pressures. The uses of monitoring wells is controversial, but may be used more widely in the future. The principal means of federal regulation of hazardous-waste injection wells is through the Underground Injection Control program, which was mandated in the Safe Drinking Water Act of 1974. Some other regulation of such wells is through the Clean Water Act and the Resource Conservation and Recovery Act. (See also W91-00900) (White-Reimer-PTT)
W91-00950

SURFACE IMPOUNDMENTS.
Brown (K.W.) and Associates, Inc., College Station, TX.
D. C. Anderson.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.55-10.62, 2 fig, 7 ref.

Descriptors: *Hazardous waste disposal, *Impoundments, *Surface impoundments, *Waste disposal, Chemical industry, Food processing industry, Liquid wastes, Regulations.

A surface impoundment (SI) is an excavation or diked area designed to contain an accumulation of liquid wastes or wastes which contain free liquids. There are two basic types of SIs used to manage hazardous waste: those designed for the ultimate disposal and those designed for the temporary storage of hazardous wastes. The largest amounts of hazardous waste placed in SIs were generated by the organic-chemical plants. The largest amounts of general waste placed in industrial SIs were generated by food processors, organic-chemical and inorganic chemical plants, and commercial waste management facilities. Most industrial SIs are at least partially used for treatment of waste. The treatment processes most widely used are neutralization, settling, anaerobic or aerobic digestion, pH adjustment, and polishing. Less than one-third of all industrial SIs were used for the ultimate disposal of wastes. A recent report prepared for the EPA detailed findings from nine case studies and several interviews with experts in the field. Major findings were: (1) land availability is the major criterion for SI site selection; (2) liner selection is based on information provided by the supplier; (3) quality assurance varies widely; and (4) experiences with flexible-membrane liners have generally not been very satisfactory. Subpart K of 40 CFR 264 gives the regulations applicable to owners and operators of new SIs used to manage hazardous wastes. These regulations cover the design, monitoring, and closure of SIs. (See also W91-00900) (White-Reimer-PTT)
W91-00951

SOIL LINERS.
Brown (K.W.) and Associates, Inc., College Station, TX.
D. C. Anderson.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.63-10.71, 5 fig, 1 tab, 23 ref.

Descriptors: *Hazardous waste disposal, *Landfills, *Liners, *Soil liners, *Waste disposal, Clay liners, Clod remnants, Hydraulic conductivity, Soil properties.

Soil liners are a required component of double-liner systems for hazardous-waste disposal facilities. For decades, engineers and scientists have assumed that soil liners constructed with compacted clayey materials would form practically impermeable hydraulic barriers. However, several recent studies have indicated that laboratory tests tend to underestimate the actual hydraulic conductivity obtained in the field. Hydraulic conductivity of a soil liner can be evaluated in the laboratory by either fixed-wall or flexible-wall permeameters. Both methods have shortcomings and advantages but it is not practical to use either method with samples large enough to be representative of field conditions. In a field study conducted on a landfill with a clayey liner, hydraulic-conductivity values obtained in the field were as much as three orders of magnitude greater than the laboratory values. One reason for the discrepancy is the presence of macrofeatures which are common in poorly compacted soil liners and in situ deposits. Macrofeatures tend to be the dominate factor in determining the effective hydraulic conductivity of in situ deposits and compacted soil liners. One of the most prevalent types of macrofeatures found in compacted-soil liners is clod remnants. These remnants are the result of the incomplete remolding of the clods that are an inevitable characteristic of uncompacted clayey borrow material. Even though a given compactor produces a high density, the liner may have a high hydraulic conductivity if clod remnants have not been removed. There is, therefore, need to supplement density tests with field hydraulic-conductivity tests in any construction quality-assurance program for soil liners. (See also W91-00900) (White-Reimer-PTT)
W91-00952

DISPOSAL IN MINES AND SALT DOMES.
GEOMIN, Inc., Tulsa, OK.
R. B. Stone.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.73-10.83, 3 fig, 14 ref.

Descriptors: *Hazardous waste disposal, *Mine disposal, *Salt domes, *Underground waste disposal, *Waste disposal, Case studies, Conventional mines, Solution mines, Technology.

The use of mined underground space for storage and disposal of hazardous materials has a long history of successful application in industrial societies. The current technology for storing hazardous waste in underground openings allows the disposal or storage of a wide range of wastes. Conventional mines can store packaged, dry, nonexplosive, nonflammable, zero-vapor-pressure wastes. Solution mines can store nonreactive liquids and slurries in bulk form; no packages are required. Design considerations for use of conventional mines include mine type, depth, rock mechanics, layout and access, safety, ventilation, and surface facilities. Considerations for solution mines are depth range, rock mechanics, layout and access, safety, cavern discharges, and surface facilities. Case studies and evaluations have been conducted for mines in Germany, Minnesota, Missouri, Ohio, and Canada. Case studies for solution mines were conducted in Canada, Holland, Texas, Louisiana, and New York. Environmental effects of the process are highly variable depending on the mine type, waste, and handling. The EPA has sponsored studies and development projects in recent years covering the fields of encapsulation, storage, and fixation technologies. Present studies, tests, and demonstrations for nuclear-waste storage are continuing in salt, basalt, tuff, and crystalline-rock formations. (See also W91-00900) (White-Reimer-PTT)
W91-00953

ABOVEGROUND DISPOSAL.
Texas A and M Univ., College Station. Center for Trace Characterization.
K. W. Brown, and D. C. Anderson.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 10.85-10.91, 3 fig, 1 tab, 5 ref.

Descriptors: *Hazardous waste disposal, *Landfills, *Waste disposal, Aboveground disposal, Costs, Design criteria, Leachates, Storage mounds, Warehouse storage.

Even after application of all available waste-reduction and treatment technologies, there is a need for long-term disposal, or storage of the residual solids. Due to the problem of contaminated leachates from underground storage, aboveground storage is recommended in some situations. There are two aboveground options which may be used: (1) warehouse storage, and (2) underdrained, aboveground storage mounds. The essential features of an aboveground storage mound consists of a sloping base which can support the weight of the waste and the cover. The liner system should consist of an upper flexible-membrane liner and a lower composite liner. A drain system consisting of stable aggregates and an appropriate system of

collection pipes should be installed over the liner. Provisions must also be made for collecting and disposing of the leachate. Depending on the nature of the waste and, in particular, the presence of toxic and mobile constituents, it may be desirable to install adsorption layers above the leachate-collection system to remove undesirable constituents leaking from the waste solids. The greatest advantage of aboveground disposal over conventional systems is that the leachate is removed immediately by gravitational drainage. The greatest disadvantage of aboveground disposal is the potential for erosion of the topsoil layer in the cover. The results of a comprehensive cost-comparison study indicated that there is no real cost difference between conventional landfills and aboveground storage mounds. (See also W91-00900) (White-Reimer-PTT)
W91-00954

SAMPLING AND MONITORING OF REMEDIAL-ACTION SITES.
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5A.
W91-00955

TREATMENT AND CONTAINMENT TECHNOLOGIES.
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
For primary bibliographic entry see Field 5G.
W91-00956

SITE REMEDIATION.
Science Applications International Corp., McLean, VA.
For primary bibliographic entry see Field 5G.
W91-00957

SAMPLING AND ANALYSIS OF HAZARDOUS WASTES.
Environmental Monitoring Systems Lab., Research Triangle Park, NC.
For primary bibliographic entry see Field 5A.
W91-00958

CONTROL AND DISPOSAL INDICES FOR COMPARING WASTE-MANAGEMENT ALTERNATIVES.
PEER Consultants, Inc., Rockville, MD.
E. Martin, and E. T. Oppelt.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 14.3-14.9, 2 tab.

Descriptors: *Alternative planning, *Hazardous waste disposal, *Hazardous wastes, *Waste management, Destructive treatment, Human health, Incineration, Management planning.

In the context of hazardous-waste management it is necessary to eliminate the hazard potential to the environment and human health, a stated goal of the Resource Conservation and Recovery Act (RCRA). In every case where management of hazardous wastes is being contemplated, a comparison of engineering alternatives should be conducted in detail to assess the potential long-term and short-term effectiveness of available options. A scheme for comparison of management options based on factors other than cost is presented. There are only two objectives possible for hazardous-waste management: (1) control for some period of time; and (2) disposal or elimination of hazard potential. An approach can be used in which each management option is treated as a 'black box.' One must estimate the quantity of expected discharges from the black box and account in some way for the time factor. It is also necessary to deal with the relative degree of disposal of hazardous-waste and toxic-waste components. In the specific engineering analysis of alternatives for specific wastes at an individual site, estimates could be made for each element necessary in the scheme and applied by using this technique. When the technique was applied, incineration and destructive treatment compared favorably to other alternatives considered, but there was a wide disparity in the values of both the control-years index and disposal index. Although 98% removal is considered very high for process treatment efficiency, the 99.9% destruction and removal efficiency for incineration represents three orders of magnitude better control. This difference between control effectiveness of the two options is reflected in the index values. Therefore, it is important to consider and report in detail process removal and destruction efficiencies in future work. (See also W91-00900) (White-Reimer-PTT)
W91-00959

COST PERSPECTIVES FOR HAZARDOUS-WASTE MANAGEMENT.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
G. M. Evans.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 14.11-14.17, 1 tab.

Descriptors: *Cost allocation, *Hazardous waste disposal, *Hazardous wastes, *Waste management, Costs, Disposal alternatives, Economic aspects.

The goal of the hazardous-waste generator is to maximize profits given the constraints imposed by environmental regulation. First and foremost management must develop a set of criteria which reflect the firm's overall goals and objectives. Next, a list of commercially available disposal alternatives must be compiled. Finally, each alternative must be carefully evaluated against the criteria, with this analysis serving as the basis for the final decision. The market for hazardous-waste disposal solutions can be viewed as two distinct submarkets: the on-site waste-disposal market; and the off-site waste-disposal market. In preparing the criteria to be evaluated the following issues must be considered: (1) the waste stream's physical characteristics; waste disposal methods for other similar wastes; corporate attitudes; the nature of the firms product market; in-house expertise; and public reaction to the disposal. In estimating disposal charges a distinction must be made between cost and price. Costs are those identifiable and accountable expenses incurred in the production of a product or service. Price is a result of the interaction of supply and demand forces in a market. For the firm beginning to investigate the range of market prices, the best source of information, short of obtaining vendor quotes, is through published price information. (See also W91-00900) (White-Reimer-PTT)
W91-00960

5F. Water Treatment and Quality Alteration

WATER SUPPLY IN FAST-GROWING CITIES: TOKYO, JAPAN.
Bureau of Waterworks, Tokyo (Japan). Water Supply Operation Centre.
For primary bibliographic entry see Field 6D.
W91-00021

MATHEMATICAL MODELLING OF THE EFFECT OF SIZE DISTRIBUTION ON SUSPENDED PARTICLES IN DEEP-BED FILTRATION.
Chia Nan Junior Coll. of Pharmacy, Tainan (Taiwan).
J. S. Chang, and S. Vigneswaran.
Aqua AQUAAA, Vol. 39, No. 2, p 96-100, April 1990. 8 fig, 7 ref.

Descriptors: *Filtration, *Hydraulics, *Mathematical models, *Particle size, *Suspended solids, *Water treatment, Adsorption, Filter breakthrough, Filter media, Hydraulic gradient, Sedimentation.

Although detailed observation shows that the size of suspended particles is one of the most important physical variables influencing deep-bed filtration, size is not often measured because the techniques available are time-consuming and expensive. A mathematical model for granular-bed filtration is presented. The model incorporates particle-size distribution and is based on the improvement of removal efficiency of finer particles in the presence of coarser particles. To explain this phenomenon, the assumption is made that all retained particles, coarse and fine, act as particle collectors in the removal of finer particles. The concept of detachment of retained particles due to hydraulic gradient is also incorporated to describe the decrease in removal efficiency during the filter breakthrough period of the filter run. The coefficients used in the model can be obtained from a laboratory-scale experiment using the suspension to be filtered. (Stoehr-PTT)
W91-00022

GENOTOXICITY OF DRINKING WATER: SIGNIFICANCE AND FUTURE APPROACH.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 5C.
W91-00023

MICROBIOLOGICAL AND CHEMICAL INVESTIGATIONS ON A BIOLOGICAL, AUTOTROPHIC DENITRIFICATION PLANT USING HYDROGEN AS AN ENERGY SOURCE.
Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Hygiene.
F. Selenka, and R. Dressler.
Aqua AQUAAA, Vol. 39, No. 2, p 107-116, April 1990. 8 fig, 4 tab, 10 ref.

Descriptors: *Biological treatment, *Denitrification, *Hydrogen, *Water treatment, *West Germany, Carbohydrates, Chemical analysis, Coliforms, Groundwater, Humic substances, Microbiological studies, Organic carbon, Organic matter, Pathogens, Pseudomonas, Water treatment facilities.

Besides physicochemical methods, there is increasing interest in biological denitrification. At Rasseln, West Germany, situated between the lower Rhine and the Dutch border, a plant has been built which uses the 'Denitropur' process. Denitrification of groundwater is performed in fixed-bed reactors by chemolithotrophic micro-organisms using hydrogen. Nitrate concentration is reduced significantly--from about 80 mg/L to less than 5 mg/L. Denitrification is accomplished mainly by Pseudomonas species. Prior to using the plant's output directly for drinking water purposes, a one-and-a-half-year experimental phase was carried out in which chemical, physical, and microbiological parameters were measured. Escherichia coli, coliforms, and pathogenic microorganisms, such as Pseudomonas aeruginosa, could not be found in the waters of the reactors or behind the filter, except for a single colony of E. coli found in December 1985 immediately after construction of the plant was completed. Total organic carbon increased only about 0.25 mg/L over the level in the incoming groundwater. The concentration and character of humic substances, mainly fulvic acids, do not change during passage through the plant. The increase in carbohydrate concentration is minimal, but a change in the carbohydrate matrix as a result of microbial activity can be demonstrated. Since July 1987, denitrified water from the Rasseln plant has been used in the common water supply. (Stoehr-PTT)
W91-00024

MEASURING ECONOMIC LOSSES FROM GROUND WATER CONTAMINATION: AN INVESTIGATION OF HOUSEHOLD AVOIDANCE COSTS.
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 5C.
W91-00086

DEVELOPMENT OF A WATER AND WASTEWATER SCADA SYSTEM.
Wiley and Wilson, Inc., Lynchburg, VA.
W. H. Clingenpeel, and D. B. Rice.
Public Works PUWOAH, Vol. 121, No. 6, p 60-62, June 1990. 1 fig.

Descriptors: *Computer programs, *Data collections, *Virginia, *Water conveyance, *Water distribution, Municipal wastewater, Municipal water, SCADA, Wastewater facilities, Wastewater management, Water delivery, Water management, Water supply.

Henrico County is urbanizing at a rapid rate and is the second most heavily populated county in Virginia. Henrico is implementing a Supervisory Control and Data Acquisition (SCADA) system that will monitor and control the entire county water system and monitor the county's wastewater system. The SCADA system will completely replace the existing hybrid monitoring and control system and will provide consistency that is currently lacking. Current technology has widened the choices of system architecture available to accomplish the SCADA mission. The computing power necessary to accomplish closed loop control in addition to data communication over leased line, radio, microwave, or satellite link is now available in a package as small as a single control loop or even a single transmitter. With the modern SCADA system, data collected at remote locations serves a two-fold purpose: control of the facility and central monitoring. The sewage pump stations and odor control facility are currently operating under their own local control systems. The new inputs to the SCADA system are designed to give operations personnel more timely information, more flexibility in setting operational alarms, quicker response to problems, and better data for planning operation and improvement strategies. The SCADA system control center will be laid out to promote quick and effective access to critical system information. It is hoped that Henrico's approach to developing its SCADA system will be helpful to others considering the implementation of water and/or wastewater SCADA systems. (Mertz-PTT)
W91-00101

COST SAVINGS THROUGH CHEMICAL ADDITION SEQUENCING.
Texas Univ. at El Paso. Dept. of Civil Engineering.
A. J. Tarquin, and D. D. Rittman.
Public Works PUWOAH, Vol. 121, No. 6, p 74-75, June 1990. 2 fig.

Descriptors: *Chemical treatment, *Cost analysis, *Economic aspects, *Water treatment, Calcium carbonate, Costs, Ferric sulfate, Lime, Mixing, Physicochemical treatment.

Chemicals are major budget items in water treatment operations. For cities treating large volumes of water, small changes in chemical dosages could result in large changes in chemical costs. A study to investigate whether cost savings could be achieved through simple operational changes in full-scale water treatment plant operations was undertaken. After establishing laboratory test conditions, jar test experiments were conducted to determine several variables, including additional flash mixing, longer mixing time, lime treatment without coagulants, and chemical addition sequencing. Laboratory jar tests revealed that a ferric sulfate dosage as low as 6 mg/L (instead of the usual 12-15 mg/L) would be sufficient if the lime were added before the primary settling tank. Changing the lime addition location obviously benefited the required iron dosage. This was probably caused by removal of calcium carbonate precipitate in the primary settling tanks, which reduced the flocculators' turbidity load. The reduction from 13.2 mg/L to 7.0 mg/L in the required coagulant dosage could not be credited solely to changing the lime addition point. However, if only a 2 mg/L reduction is attributed to this change, at a ferric sulfate cost of $187 per ton, the cost savings would be over $15,000 for the 6.5-month river operation season at a 50 million gallon/day flow rate. At 6% per year interest, the present worth of these savings through ten years would exceed $110,000. These savings would be proportionally multiplied for higher flow rates and/or a longer operating season. (Mertz-PTT)
W91-00102

TREATMENT OPTIONS FOR WATER SUPPLIES CONTAMINATED WITH DBCP AND OTHER PESTICIDES.
Brown and Caldwell, Walnut Creek, CA.
J. M. Wong.
Public Works PUWOAH, Vol. 121, No. 6, p 78-81,115, June 1990. 5 fig, 4 tab, 17 ref.

Descriptors: *Pesticides, *Water quality management, *Water treatment, Activated carbon, Air stripping, Decontamination, Groundwater pollution, Herbicides, Oxidation, Reverse osmosis, Ultraviolet radiation, Water pollution.

Contamination of water supplies by pesticides (or herbicides) is a significant public health problem because of the widespread application of pesticides in large-scale agriculture and in forest areas. Contamination can occur through drainage from the surrounding terrain, precipitation from the atmosphere, accidental spills, and leaching into groundwater through fumigated soil. When groundwater used for drinking water supplies is contaminated by pesticides or other organic chemicals, remedial actions by municipalities or water purveyors are required to protect public health and to meet drinking water standards. Remedial alternatives to control the level of contaminants in the water can be nontreatment or treatment methods. Nontreatment alternatives may include changing the groundwater source through well replacement and well rehabilitation, increasing the production of good quality sources with storage, and blending of poor quality water with better quality water. Nontreatment methods are usually less expensive than treatment methods, if they can be technically implemented. Treatment methods include common organic removal processes such as air stripping, activated carbon adsorption, oxidation enhanced by ultraviolet irradiation, and reverse osmosis. Treatment usually occurs at the wellhead or at a central location with a cluster of wells, if feasible. (Mertz-PTT)
W91-00103

COMPUTER-OPERATED TREATMENT PLANT PROVIDES TOP QUALITY WATER.
Bogert (Clinton) Associates, Fort Lee, NJ.
W. Eakins.
Public Works PUWOAH, Vol. 121, No. 6, p 87-89, June 1990. 3 fig.

Descriptors: *Automation, *Computer programs, *Massachusetts, *Water conveyance, *Water distribution, *Water treatment, Computers, Conveyance structures, Pumping plants, Storage tanks, Water storage, Water treatment facilities.

Lynn, Massachusetts faced complicated and extensive water supply issues. A 20-year program culminated in the Lynn Water and Sewer Commission building a new 23-million gallon/day water treatment facility. The water commission supplies water for about 80,000 residents. A water main cleaning and lining program rehabilitated most major water mains over 12 inches in diameter in 125 miles of mains. Two prestressed concrete water storage tanks were built, each storing 3 million gallons of water. The plant's computer system, automatically controls filter backwashing, operates the low service pumping station pumps, and logs and displays operating data. During monitoring, the computer reads and scans through two types of input signals--discrete and analog--wired to it from over 250 pieces of plant equipment. Under the control function, the computer generates output signals to over 100 pieces of equipment and directs valve openings and closings, stopping and starting plumps, and regulating flow rates. As the overall system was designed, the basic components are the network monitor, the remote distributed controllers in the computer cabinet, and the process engineers interface. Lynn's treatment plant computer system gives supervisory personnel or process engineers two extremely powerful and useful tools--centralized and flexible monitoring of process equipment, and automated control of plant processes. (Mertz-PTT)
W91-00106

UPGRADING THE OWL'S HEAD WASTEWATER TREATMENT PLANT.
Metcalf and Eddy of New York, NY.
For primary bibliographic entry see Field 5D.
W91-00107

SUMMERTIME SAMPLING.
Southern Illinois Univ. at Edwardsville. Environmental Resources Training Center.
For primary bibliographic entry see Field 5A.
W91-00111

OPTIMAL VALVE CONTROL IN WATER-DISTRIBUTION NETWORKS.
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Civil Engineering.
P. W. Jowitt, and C. Xu.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 455-472, July/August 1990. 11 fig, 3 tab, 19 ref.

Descriptors: *Flow control, *Leakage, *Water conveyance, *Water distribution, Algorithms, Hydraulic valves, Mathematical equations, Optimization, Water supply.

The primary duty of a water supply undertaking is the consistent provision of water in sufficient quantity, at appropriate pressure, of acceptable quality, as economically as possible. The problem of operational-leakage control has received relatively less attention. It has been reported that leakage from some networks may account for a significant amount of the water put into supply. For some aging urban networks, rates of up to 50% have been reported, with average rates of 25% being quite typical. These high rates of leakage represent a significant economic loss. An algorithm for the determination of flow control valve settings to minimize leakage has been developed. The nonlinear network equations describing nodal heads and pipeflows are augmented by terms that explicitly account for pressure-dependent leakage and by terms that model the effect of valve actions. Successive linearization of these equations using the linear-theory method allows the formulation and solution of a linear program that minimizes leakage. This mathematical representation derives from data collected from a specified set of field experiments, and may not be representative of other circumstances, but it is hoped that the technique will stimulate further interest, both analytical and experimental, in the estimation of leakage in distribution networks. (Fish-PTT)
W91-00180

BEHAVIORAL CHANGES IN GAMMARUS PULEX AND ITS SIGNIFICANCE IN THE TOXICITY ASSESSMENT OF VERY LOW LEVELS OF ENVIRONMENTAL POLLUTANTS.
Reading Univ. (England). Dept. of Physiology and Biochemistry.
For primary bibliographic entry see Field 5C.
W91-00207

WATER RESOURCES OF THE WHITE EARTH INDIAN RESERVATION, NORTHWESTERN MINNESOTA.
Geological Survey, St. Paul, MN. Water Resources Div.
J. F. Ruhl.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4074, 1989. 73p, 30 fig, 8 tab, 35 ref.

Descriptors: *Groundwater data, *Indian reservations, *Minnesota, *Potable water, *Water quality, *Water resources, *Water resources data, Ecology, Esthetics, Recreation, Water use, White Earth Indian Reservation.

Water resources in the White Earth Indian Reservation meet the present (1988) needs for potable supply and other household use and provide valuable ecological, recreational, and aesthetic benefits. Total annual water use in the reservation is about 460 million gallons per year. Domestic supply from

privately-owned wells and municipal systems accounts for roughly 75% of the water use, and irrigation of croplands and nurseries accounts for approximately 25%, depending on rainfall. Glacial-drift aquifers are the source of groundwater in the reservation. Unconfined-drift aquifers consist of two superficial outwash deposits that extend over approximately 20% of the reservation. Confined-drift aquifers are discontinuous lenses of sand and gravel that are poorly connected to each other. The aquifers are 50 to 300 feet below land surface and 5 to 25 feet thick. Yields from these aquifers typically range from 10 to 100 gallons per minute. Surface water in the reservation consists of numerous lakes, wetlands, prairie potholes, and streams. The larger, deeper lakes in the eastern and southern parts of the reservation support game fish and provide recreational opportunities for swimming and boating. The shallower lakes and prairie potholes are used to produce wild rice and also are managed to provide waterfowl habitat. Groundwater is mostly a calcium magnesium bicarbonate type. Dissolved solids concentration of the groundwater generally is greater in the deeper confined-drift aquifers than in the shallower unconfined-drift aquifers. Except for elevated concentrations of iron and manganese, groundwater quality meets Environmental Protection Agency drinking water criteria. Surface water also is a calcium magnesium bicarbonate type. Lake waters are hard and alkaline and mesotrophic to eutrophic. Quality of the lake and stream water is suitable for native forms of freshwater biota, although the concentration of mercury exceeds the 0.012 micrograms per liter maximum contaminant level. Available information, however, indicates that the amount of mercury in edible tissue from fish in alkaline lakes of northwestern Minnesota is within safe limits. The concentrations of phosphorus and nitrate in the streams are below levels that indicate pollution problems. (Author's abstract)
W91-00341

ACCURACY OF HYDRANT FLOW TESTS USING A PITOT DIFFUSER.
Wyoming Valley Sanitary Authority, Wilkes-Barre, PA.
For primary bibliographic entry see Field 7B.
W91-00378

TRANSIENT ANALYSIS OF WATER DISTRIBUTION SYSTEMS.
Toronto Univ. (Ontario). Dept. of Civil Engineering.
B. W. Karney, and D. McInnis.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 7, p 62-70, July 1990. 10 fig, 2 ref.

Descriptors: *Hydraulic models, *Hydraulic transients, *Hydraulics, *Water delivery, *Water distribution, Computer models, Hydraulic loading, Mathematical analysis, Mathematical equations, Mathematical models.

Physical load factors on pressure pipe systems can cause failures such as a break that causes loss of water and pressure or more systemic problems, such as increased fluid friction with its associated reduced flow capacity, increased power costs, or both. One source of loading that is commonly neglected in water distribution system analysis is due to transient (water hammer) conditions. The pressures generated by transient conditions in pipe systems are frequently three or more times the value of normal operating pressures. Thus, transient pressures must be know if the size and strength of the required pipe is to be rationally selected, if surge-suppression equipment is to be logically sized, and if system operating rules are to be intelligently specified. In practice, however, analysts frequently neglect transient conditions, particularly in complex systems such as distribution networks. With modern computer techniques it is possible to analyze distribution systems under a wide range of flow conditions and with relatively few restrictions. (Author's abstract)
W91-00379

SUGGESTED METHODS FOR CALCULATING AND INTERPRETING CALCIUM CARBONATE SATURATION INDEXES.
For primary bibliographic entry see Field 2K.
W91-00380

MEASUREMENT OF BIODEGRADABLE ORGANIC MATTER AND BACTERIAL GROWTH POTENTIAL IN DRINKING WATER.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
P. M. Huck.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 7, p 78-86, July 1990. 2 fig, 5 tab, 57 ref.

Descriptors: *Biodegradation, *Dissolved solids, *Laboratory methods, *Pollutant identification, *Reviews, *Water analysis, *Water delivery, *Water treatment, Bacteria, Biomass, Dissolved organic carbon, Organic carbon, Water distribution.

The water industry has become increasingly interested in the biodegradability of natural organic matter present in both raw and treated water, due to its role in promoting microorganism growth in such water. A number of methods have recently been developed to measure the biodegradability of aquatic natural organic matter. These techniques measure assimilable organic carbon, biodegradable organic carbon or bacterial growth potential. This article reviews the various methods and summarizes their application to the assessment of treatment processes and bacterial growth in distribution systems. Biomass-based methods are the subject of a major philosophic difference as to whether the most appropriate inoculum is one or more known bacterial strains or an indigenous bacterial population. The biodegradability methods have been successfully applied to measure the effects of treatment processes. Limited use has been made thus far of the methods in the design of treatment processes and optimization of their operation. Further research quantifying the relationship between biodegradability and bacterial growth in distribution systems is required before biodegradability can be effectively used as a design parameter. Currently, none of the methods can be considered ready for routine use in water treatment practice, although efforts to develop a procedure that could be more widely used are in progress. (Hoskin-PTT)
W91-00381

DISINFECTING BIOFILMS IN A MODEL DISTRIBUTION SYSTEM.
American Water Works Service Co., Inc., Belleville, IL. Belleville Lab.
M. W. LeChevallier, C. D. Lowry, and R. G. Lee.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 7, p 87-99, July 1990. 17 fig, 9 tab, 34 ref.

Descriptors: *Biofilms, *Chlorination, *Disinfection, *Water delivery, *Water distribution, *Water treatment, Bacteria, Chlorine, Copper, Corrosion, Iron, Laboratory methods, Model studies, Physical models, Pipes.

Maintenance of a chlorine residual does not eliminate all bacteria in a water distribution system. The study examined the disinfection efficiency of free chlorine and monochloramine for controlling biofilm organisms in a model pipe system. The composition of the pipe material was found to be a major influence on disinfection efficiency. Bacteria grown on galvanized copper, or polyvinylchloride pipe surfaces were readily inactivated by a 1-mg/L residual of free chlorine or monochloramine. Biofilms grown on iron pipes treated with free chlorine doses as high as 4 mg/L (3-mg/L residual) for two weeks did not show significant changes in viability, but if treated with 4 mg/L of monochloramine for two weeks, these biofilms exhibited a more than 3-log die-off. Accumulation of corrosion products on iron pipes was found to interfere with free chlorine disinfection. (Author's abstract)
W91-00382

DISINFECTION OF DRINKING WATER BY FILTRATION THROUGH SILVER IMPREGNATED ALUMINA.
Industrial Toxicology Research Centre, Lucknow (India).
R. K. Sharma, S. Kumar, P. W. Ramteke, and P. K. Ray.
Journal of Environmental Science and Health (A) JESEDU, Vol. 25, No. 5, p 479-486, July 1990. 3 tab, 18 ref.

Descriptors: *Coliforms, *Disinfection, *Drinking water, *Filtration, *Silver, *Water treatment, Alumina, Bacteria, Escherichia coli, Water supply.

A system for the disinfection of drinking water by silver ions was devised. Immobilized metallic silver ion on alumina was found to be effective in the removal and inactivation of thermotolerant Escherichia coli within 10 to 15 seconds of contact time. In the process, bacteria are not only adsorbed on the solid support but are also inactivated due to the bactericidal and bacteriostatic effects of silver ions. This filter material may potentially be useful for the disinfection of potable water for individual and community water systems. (Author's abstract)
W91-00391

SPECIFER'S GUIDE TO POLYMER FEED SYSTEMS.
For primary bibliographic entry see Field 5D.
W91-00402

CORROSION AND WATER QUALITY.
Wisconsin Dept. of Natural Resources, Spooner. Northwest District.
For primary bibliographic entry see Field 5B.
W91-00411

WHAT TO CONSIDER WHEN SELECTING YOUR WATER SUPPLY.
Ernst and Young.
Water Well Journal WWJOA9, Vol. 44, No. 6, p 55-63, June 1990. 10 fig.

Descriptors: *Domestic water, *Water conveyance, *Water supply, *Wells, Costs, Rural areas, Water quality, Water quality standards, Well testing.

When a homeowner has the opportunity to select his or her water supply, there are certain questions that need to be answered in order to make an informed decision. To help decide between a rural public water provider and a well water system, the homeowner must consider the availability and safety of the water supply, the short-term and long-term costs, as well as the ability to receive adequate amounts of water when needed. These factors can be determined by discussing with the rural water provider their plans to meet demand as the area develops, whether current water quality meets standards set by the federal government, and the connection costs to obtain service and operating costs. By considering and comparing these aspects of using a rural water provider to the same concerns applied to a well water system, the homeowner should be able to make an informed decision. Worksheets for determining and comparing these costs for both options are provided. (Fleishman-PTT)
W91-00414

COST AND PERFORMANCE OF MEMBRANES FOR ORGANIC CONTROL IN SMALL SYSTEMS: FLAGLER BEACH AND PUNTA GORDA, FLORIDA.
University of Central Florida, Orlando. Dept. of Civil Engineering and Environmental Sciences.
J. S. Taylor, L. A. Mulford, W. M. Barrett, S. J. Duranceau, and D. K. Smith.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-190367/AS. Price codes: A12 in paper copy, A01 in microfiche. Report No. EPA/600/2-89/022, May 1989. 272p, 115 fig, 95 tab, 16 ref. Cooperative Agreement No. CR 813199.

Descriptors: *Costs, *Filtration, *Florida, *Membrane processes, *Water treatment, Capital costs,

Fouling, Operating costs, Performance evaluation, Pilot plants.

The performance and cost of low pressure membrane technology to remove THM precursors from drinking water is documented. A 12,500 gpa membrane pilot plant was operated for one year at both groundwater and surface water source test sites in Florida. At the groundwater site, the pilot plant was operated for over 5,000 hr and produced a permeate with an average THMFP of 20 microg/L from a source water with an average THMFP of 400 microg/L. Permeate production was consistent throughout the operating period. There were no significant operational problems. A preliminary cost estimate showed that the cost of a low pressure membrane treatment facility was essentially equal to that of the existing lime softening treatment and produced drinking water of generally superior quality. At the surface water site, the pilot plant was operated for over 6,600 hr and produced a permeate with an average THMFP of 37 microg/L from a source water with an average THMFP of around 600 microg/L. Consistent permeate production was not achieved at this location, however, as a significant problem with fouling of the membranes by the highly organic surface water was encountered. Use of this type of membrane technology on such surface water will require lower membrane flux, lower recovery, more frequent membrane cleaning and extensive pretreatment. Capital costs for such an application will be significantly higher than conventional treatment. (Author's abstract)
W91-00448

SOC (SYNTHETIC ORGANIC COMPOUNDS) REJECTION BY NANOFILTRATION.
University of Central Florida, Orlando. Dept. of Civil Engineering and Environmental Sciences.
J. S. Taylor, S. J. Duranceau, L. M. Mulford, D. K. Smith, and W. M. Barrett.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-194245/AS. Price codes: A07 in paper copy, A01 in microfiche. Report No. EPA/600/2-89/023, May 1989. 142p, 56 fig, 58 tab, 13 ref. Cooperative Agreement No. CR 813199.

Descriptors: *Filtration, *Fumigants, *Membrane processes, *Pesticides, *Synthetic compounds, *Water treatment, Adsorption, Mass balance, Membranes, Molecular structure, Pilot plants.

A study was conducted to evaluate the rejection of six synthetic organic compounds (SOCs) from a potable water source by a nanofiltration membrane process. The SOCs were ethylene dibromide (EDB), dibromochloropropane (DBCP), chlordane, heptachlor, methoxychol and alachlor. To investigate SOC rejection, a membrane pilot plant was constructed that utilized a single, 4-in by 40-in FilmTec N 70 spiral wound, thin film composite membrane with a molecular weight cutoff of 300. The effects of different operating pressures and membrane feed stream velocities on membrane rejection of SOCs are reported. Trihalomethane formation potential (THMFP) and total organic halide formation potential (TOXFP) and general water quality in and out of the membrane are also reported. Accurate organic and inorganic mass balances were conducted in solutes. The percent rejection of the SOCs varied from 0% for EDB to 100% for chlordane, methoxychlor, heptachlor and alachlor. DBCP was the only partially rejected SOC in the group. Mass balances conducted during each SOC test indicated that adsorption could have occurred within the membrane system for the three highest molecular weight SOCs tested; methoxychlor, heptachlor and chlordane. Although breakthrough of adsorbed SOCs did not occur during these short-term tests, it could occur if the adsorption capacity of the membrane is reached. (Author's abstract)
W91-00449

SUPERFUND RECORD OF DECISION: BEACHWOOD/BERKELEY, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W91-00451

WATER CHLORINATION: CHEMISTRY, ENVIRONMENTAL IMPACT AND HEALTH EFFECTS. VOLUME 6.
Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. 1023p.

Descriptors: *Chemical analysis, *Chlorination, *Environmental effects, *Public health, *Water treatment, Conferences, Disinfection, Epidemiology, Toxicology.

This book represents the proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects held May 3-8, 1987 in Oak Ridge, Tennessee. Most of the research that occurred between the fifth and sixth conferences was documented at this meeting. Chapters in this volume fall into ten section headings: The Stage, The Mutagen/Carcinogen, The Toxicology, The Epidemiology, The Environment, The Water, The Other By-Product/Compound, The Chemistry, The Disinfection, and The Perspective. (See W91-00477 thru W91-00551) (Lantz-PTT)
W91-00476

INTERIM: SELECTED CHEMICAL RESEARCH REPORTED BETWEEN CONFERENCES FIVE AND SIX.
Oak Ridge National Lab., TN.
R. L. Jolley, and J. D. Johnson.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 3-19, 1 tab, 55 ref.

Descriptors: *Chlorination, *Literature review, *Research priorities, *Water pollution effects, *Water treatment, Chemical analysis, Chlorine compounds, Measuring instruments, Organic compounds, Oxidation, Water quality control.

In this brief literature review, an attempt is made to summarize the research on water chlorination that was published in the interval between 1984-1987. Four commercial on-line total residual chlorine analyzers for wastewater were bench tested. The analyzers were representative of the major instrument types: amperometric, colorimetric, and potentiometric. Although some deficiencies were noted, all had acceptable accuracy spans. Artifact problems in analytical chemistry are presented, specifically with respect to cyclohexene which is used as a preservative in methylene chloride. Consequently, use of methylene chloride to extract water samples containing free or active chlorine residuals commonly produces the following artifacts at micro g/L levels: chlorocyclohexenes, dichlorocyclohexane, chlorocyclohexanone, and chlorocyclohexanol. Diethyl ether extracts comprise nearly 100% of the mutagenic activity from aqueous solutions of chlorinated humic acids. Diacetone alcohol was found to be an artifact of processes involving acetone extraction and weakly basic Florisil (magnesium silicate) adsorbents. The effect of permanganate oxidation and chlorination on the mutagenic activity of recharged groundwater processed from humic-rich surface water was studied in Kuopio, Finland. The mutagenic activity of chlorinated water in this area is very high and attributable to the high organic content of the lake that is the raw water source. (See also W91-00476) (Lantz-PTT)
W91-00477

WATER CHLORINATION: THE CHALLENGE.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
J. D. Johnson, and R. L. Jolley.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 21-27, 22 ref.

Descriptors: *Chlorination, *Disinfection, *Public health, *Water treatment, Human diseases, Standards, Water quality, Water quality control.

The challenge of modern day water chlorination is to reap the benefits of chlorine's excellent disinfection efficacy while minimizing its environmental impacts and by-product toxicity. Waterborne diseases such as typhoid, cholera, dysentery, amebiasis, salmonellosis, shigellosis, and hepatitis A have greatly decreased in the U.S. in the last 80 years, in part, due to chlorination. Only recently has data become available on the efficacy of chlorine against some of the more difficult to disinfect waterborne disease microorganisms such as hepatitis A virus and Giardia lamblia parasitic cysts. There is a large effort currently being mounted to use the laboratory-determined concentration, C, times time, t, or the C X t dose required for a constant fraction of disinfection, to meet the drinking water disinfection requirements of the filtration and disinfection rule promulgated by the EPA as part of the 1986 amendments to the Safe Water Drinking Act. Disinfectants must gain access to the sensitive sites of organisms through protective layers of reducing agents and other organisms aggregated or on surfaces. These protective layers not only slow down, but also exert a demand on the disinfectant, reducing it to an ineffective chemical form. (See also W91-00476) (Lantz-PTT)
W91-00478

CURRENT STATUS OF DISINFECTANT RESIDUAL MEASUREMENT METHODS FOR FREE AND COMBINED CHLORIDE AND OXYCHLORINE SPECIES.
Miami Univ., Oxford, OH. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-00479

SOUTH AUSTRALIAN WATER: A DISINFECTION PROBLEM.
South Australian Health Commission, Adelaide.
C. C. Baker, and D. B. Bursill.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 47-59, 9 tab, 43 ref.

Descriptors: *Australia, *Chlorination, *Disinfection, *Public health, *Trihalomethanes, *Water quality, *Water treatment, Chlorine, Human diseases, Toxicity.

Australia is the driest inhabited continent in the world with the largest proportion of the continent receiving < 300 mm of rainfall annually. The population of South Australia is about 1.4 million, with the majority (73%) living in and around Adelaide. In a state with such small amounts of this rainfall, water is a precious resource to the community. To conserve this resource, rainwater tanks and irrigation systems are used extensively. The available groundwater is generally unsuitable for water supply purposes because of high salinity. Consequently, the generation of trihalomethanes (THMs) from surface waters containing relatively high levels of naturally occurring organic material is a problem affecting most of the state's population. A second problem arises from the need to pipe the water over long distances where the ambient temperatures are high. Water at elevated temperatures preferentially encourages the growth of an amoeba, Naegleria fowleri, the organism that causes an often fatal meningitis. To combat the growth of this organism and to adequately disinfect the water require large amounts of chlorine. Chlorine is added at various dosing stations along these pipelines and levels of up to 25 mg/L chlorine have been used to ensure effective disinfection. A review of the literature revealed that the strongest evidence was for an association between chlorinated organic contaminants and cancers of

the rectum, and to a lesser degree, cancers of the colon and bladder. A case-control interview study of 2982 incident cases of bladder cancer and 5782 randomly selected population-based controls was undertaken. In addition, results from long-term feeding experiments show that an increased incidence of tumors was only seen at high doses and often at levels which were clearly toxic to the liver and kidney. Most of the chronic studies used high doses to produce tumors, but unfortunately, sufficient lower doses were not included to allow establishment of no-effect levels (NELs). A program for the construction of water filtration facilities for the major South Australian water supplies has been in progress since the early 1970s. (See also W91-00476) (Lantz-PTT)
W91-00480

CHLORINATED HYDROCARBONS AND WATER QUALITY ISSUES IN THE NEW YORK CITY MUNICIPAL WATER SUPPLY.
Lamont-Doherty Geological Observatory, Palisades, NY.
R. F. Bopp, B. L. Deck, H. J. Simpson, and S. D. Warren.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 61-74, 5 fig, 4 tab, 18 ref.

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Disinfection, *Municipal water, *New York, *Trihalomethanes, *Water quality, *Water treatment, Chlorine compounds, Chloroform, Delaware River, Hudson River, Organic carbon, Raw water.

Two groups of laboratory incubation experiments were performed on NYC raw water sources. The first, included (1) unfiltered Chelsea raw water, (2) filtered Chelsea raw water, and (3) unfiltered Rondout raw water. Over the course of 100 h, the total trihalomethane (TTHM) levels in the tree sample sets reached 191, 165, and 33 ppb respectively. Thus, both the Chelsea sample sets were five to six times higher in THM production than the Rondout samples. THM levels in filtered Chelsea samples were generally lower than, but within 15% of, corresponding values in the unfiltered Chelsea set. All three sets had monotonically increasing chloroform (CHCL3) levels with time since chlorination began. The Hudson River water during late fall 1985 had two to three times the dissolved organic carbon (DOC) levels of water in the Delaware watershed reservoirs and streams. Hudson River samples produced about 35 ppb TTHMs/mg/L DOC, while Delaware System water yielded about 15 ppb TTHMs/mg/L DOC. Water withdrawn from the Hudson at Chelsea contains PCBs originally discharged to the river far upstream of tidal waters over a period of several decades. Even undiluted treated Hudson River water does not exceed federal or state standards for dissolved PCBs in drinking water. The limited TTHM data available for NYC drinking water show the TTHM levels in the water generally average <50% of the level currently permitted in the US for large municipal water supplies. (See also W91-00476) (Lantz-PTT)
W91-00481

HEALTH EFFECTS OF DISINFECTANTS AND DISINFECTION BY-PRODUCTS: A REGULATORY PERSPECTIVE.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
J. Orme, C. S. Mullin, and E. V. Ohanian.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 75-86, 56 ref.

Descriptors: *Chlorination, *Disinfection, *Public health, *Water pollution effects, *Water treatment, Chloramines, Chlorine, Chlorine compounds, Drinking water, Toxicity, Trihalomethanes.

The Safe Drinking Water Act (SDWA) requires the EPA to specify drinking water contaminants that may have any adverse effect on public health. For each of these contaminants, the EPA must set a maximum contaminant level (MCL). Chlorine is the most widely used disinfectant in the US and does not appear to be acutely toxic. In short-term toxicity studies, the liver and kidney appear to be target organs. Chlorine dioxide has often been used in conjunction with chlorine during drinking water disinfection to control phenolic tastes and odors. It has also proven to be an effective disinfectant with nearly 2.5 times the oxidizing power of chlorine. Chlorine dioxide degrades into chlorite and chlorate. Chloramines are also used as an alternative to chlorine for drinking water disinfection. Human studies were negative for chloramines in volunteers receiving 0.2 mg/L in drinking water for 84 d. The trihalomethanes, consisting of chloroform, bromoform, bromodichloromethane, and dibromochloromethane, are formed from the reaction of chlorine with organic matter in the water during the disinfection process. A number of other substances or treatment practices have been used in drinking water disinfection, including ozone, iodine, bromine, potassium permanganate, silver, ferrate, high pH, ionizing radiation, and ultraviolet light. The available health effects information on these substances is extremely limited. (See also W91-00476) (Lantz-PTT)
W91-00482

REGULATORY EFFECTS ON THE PRACTICE OF DRINKING WATER TREATMENT.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
S. W. Clark, and J. A. Contruvo.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 87-100, 1 tab, 6 ref.

Descriptors: *Chlorination, *Disinfection, *Drinking water, *Public health, *Regulations, *Standards, *Water treatment, Filtration, Maximum contaminant level, Protozoa, Viruses, Water quality, Water quality control.

The Safe Drinking Water Act (SDWA) offers two options for regulating drinking water contaminants. The first is to set technology-based maximum contaminant levels (MCLs) as close to a health-based MCL goal (MCLG) as is feasible. Contaminants for which monitoring is not technically or economically feasible may be regulated by setting treatment technique requirements. The second option involves the treatment of surface waters, and disinfection of all waters through filtration for microbial contaminants, a number of which can not be measured. The primary distinction between an MCL and a treatment technique requirement is the ability to monitor for a particular contaminant. The practice of water treatment will be impacted by the new drinking water standards in several areas: (1) establishing new treatment systems; (2) providing technologies that are cost-effective and simple to operate; (3) increased emphasis on microbiological safety. Agents of concern will include viruses, Giardia, and other protozoans, bacteria and Legionella; and (4) improving microbiological safety while reducing human exposure to disinfectants and their by-products. (See also W91-00476) (Lantz-PTT)
W91-00483

TRIHALOMETHANES: IS SWIMMING POOL WATER HAZARDOUS.
J. Copaken.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 101-104, 2 tab, 7 ref.

Descriptors: *Chlorination, *Disinfection, *Public health, *Swimming pools, *Trihalomethanes, *Water treatment, Chlorinated hydrocarbons, Organic compounds, Path of pollutants, Recreation, Volatile organic compounds.

Trihalomethanes (THMs), carcinogenic compounds formed through the chemical reaction of chlorine and organic materials in aqueous solution, are problems in some drinking water. However, the formation of THMs and other chorooorganic compounds during the chlorination of swimming pool waters has received scant attention. Previous research indicated the following: the average concentration of THMs in chlorinated freshwater swimming pools is 150 microgram/L; THMs are volatile, and an equilibrium is established in indoor pools between THMs present in the swimming pool water and those in the surrounding atmosphere; THMs enter the body through inhalation, adsorption, and the gastroenteric system (drinking of the water), although inhalation is the predominant mechanism; once in the body, THMs bond with fat, blood, and brain tissues; and the depuration rate for THMs in the human body is greater than 24 hr. The goal of the research reported in this paper is to measure the concentrations of chloroform in a chlorinated swimming pool's water and to determine whether chloroform (and therefore THMs) enters the bodies of swimmers in the pool or is inhaled by workers exposed to the atmosphere surrounding the pool. After a 2-hr exposure to chlorinated water containing 37.9 microgram/L chloroform, the average increase in the blood chloroform concentration in five volunteers was 0.61 microgram/L. A similar study with two volunteers in an electronically purified swimming pool containing 3.6 microgram/L chloroform resulted in a 0.48 microgram/L decrease in the blood chloroform level. It is concluded that THMs may present a hazard to lifeguards or occupationally exposed persons and to competitive swimmers exposed for long periods to chlorinated swimming waters. (See also W91-00476) (Lantz-PTT)
W91-00484

PRODUCTION OF ORGANIC CHEMICALS AND MUTAGENS DURING CHLORINATION OF AMINO ACIDS IN WATER.
Water Research Centre, Medmenham (England). Medmenham Lab.
H. Horth, M. Fielding, H. A. James, M. J. Thomas, and P. Wilcox.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 107-124, 15 ref.

Descriptors: *Amino acids, *Chlorination, *Disinfection, *Organic compounds, *Water pollution sources, *Water treatment, Chlorine compounds, Chloroform, Hydrogen ion concentration, Mutagens, Tyrosine.

Bacterial mutagenicity assays on concentrated extracts of drinking water have shown the presence of chemical mutagens. It has also been shown that mutagenic activity is produced during drinking water disinfection as a result of the reaction of chlorine with naturally occurring compounds such as humic and amino acids. Some amino acids produce mutagenic activity on aqueous chlorination similar in character to that generated during chlorination of natural waters. However, the low amounts of free amino acids present in such waters are likely to account for only a small portion of the mutagenic activity generated. Different mutagens can be extracted by altering the pH of the aqueous chlorinated solution. Chlorination of tyrosine produced considerable mutagenic activity, but when examined by the pH 6.2/XAD method the primary mutagens could not be identified; pH 2/XAD extracts of tyrosine, 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX) accounted for much of the mutagenicity. Tyrosine appears to be an interesting model compound for studying the production of mutagenic compounds during water treatment by chlorination. Not only is tyrosine a precursor of potent mutagenic activity of similar characteristics to that observed in drinking water,

but many of the products so far identified in chlorinated tyrosine have been found in drinking water and in chlorinated humic acid. These include E-MX, MX, chloroform, chloral, dichloroacetonitrile, hydroxybenzlcyanide, and chlorophenols. (See also W91-00476) (Lantz-PTT)
W91-00485

FORMATION AND PROPERTIES OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE, A POTENT MUTAGEN IN CHLORINATED WATERS.
Abo Akademi, Turku (Finland). Lab. of Forest Products Chemistry.
For primary bibliographic entry see Field 5B.
W91-00486

IDENTIFICATION OF THE STRONG MUTAGEN 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE AND ITS GEOMETRIC ISOMER E-2-CHLORO-3-(DICHLOROMETHYL)-4-OXOBUTENOIC ACID IN MUTAGENIC FRACTIONS OF CHLORINE-TREATED HUMIC WATER AND IN DRINKING WATERS.
Environmental Protection Agency, Cincinnati, OH.
L. Kronberg, B. Holmbom, and L. Tikkanen.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 137-146, 7 fig, 2 tab, 13 ref.

Descriptors: *Chlorination, *Disinfection, *Drinking water, *Organic compounds, *Water pollution sources, *Water treatment, Ames test, Mutagens.

Many studies have demonstrated that concentrates of drinking waters exhibit mutagenicity in the Ames test. The practice of water chlorination has been shown to be responsible for the formation of mutagenicity. The mutagenic activity in extracts of chlorine-treated water seemed to be derived quantitatively from the strong Ames mutagen MX. In drinking water extracts, the compound was estimated to account for 20% to 50% of the total TA100 activity. The geometric isomer of MX, E-MX, has been tentatively identified in a mutagenic fraction of chlorine-treated humic water. The compound exhibited at most 10% of the MX mutagenicity. EX-MX was found in extracts of chlorinated humic and drinking waters at approximately the same concentration levels as MX and thus accounted only for marginal proportions of the activity in the extracts. Under the acid conditions, E-MX has the ability to isomerize to MX, but the isomerization rate seems to be too slow to cause any significant increase in the activity of consumed water. Although these results indicate that E-MX is not an important mutagen, the properties of E-MX have to be further evaluated until the compound can be excluded from discussions concerning drinking water mutagens. (See also W91-00476) (Lantz-PTT)
W91-00487

COMPARISON OF MUTAGENIC ACTIVITY OF CHLORINATED AQUATIC AND COMMERCIAL HUMIC SUBSTANCES.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W91-00488

IMPORTANCE OF GLUTATHIONE IN THE IN VITRO DETOXIFICATION OF 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE, AN IMPORTANT MUTAGENIC BY-PRODUCT OF WATER CHLORINATION.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W91-00489

CHLORINATION OF AQUATIC FULVIC ACID AND NATURAL WATERS: ADDITIONAL BY-PRODUCTS.
ENVIRON Corp., Washington, DC.
G. P. Thompson, R. F. Christman, and J. D. Johnson.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. 171-178, 6 fig, 3 tab, 8 ref.

Descriptors: *Chlorination, *Disinfection, *Fulvic acids, *Natural waters, *Water pollution sources, *Water treatment, Chlorine compounds, Chloroform, Organic compounds, Trihalomethanes, Volatile organic compounds.

Since the initial findings of chloroform and other trihalomethanes (THMs) in chlorine-treated drinking water, a large number of by-products have been observed. The by-products may be divided into the following classes: (1) chloroform and other THMs; (2) other purgeable chlorinated organic by-products; (3) trichloroacetic acid (TCAA), dichloroacetic acid (DCAA), and other short-chain chlorinated acids; (4) chlorohydroxyfuranones (CHFs) and chloroform precursors; and (5) recalcitrant by-products. Research was performed to determine if additional purgeable (volatile) by-products and extractable nonvolatile by-products could be isolated from chlorinated natural waters and fulvic acid solutions. Analyses of chlorinated high humic water and fulvic acid solutions yielded several significant results. Many volatile (purgeable) chlorinated organic compounds are produced by chlorination. But the concentrations of these compounds indicate that they do not account for a preponderance of the total organic halides (TOX). Short chain chlorinated acids are the predominant extractable by-products under the conditions used. The extremely important mutagen MX has been detected as a by-product of chlorination of both a pristine natural surface water and an aquatic prepared fulvic solution. The quantities of MX observed are very small; concentrations of < 2ng/L were observed. There is mass spectral evidence for additional chlorohydroxyfuranones or straight-chained analogs, but insufficient concentrations were obtained to confirm structures by mass spectral analysis. (See also W91-00476) (Lantz-PTT)
W91-00490

MUTAGENICITY OF THE NONVOLATILE REACTION PRODUCTS OF AQUEOUS CHLORINATION OF L-TRYPTOPHAN.
Florida Univ., Gainesville. Dept. of Food Science and Human Nutrition.
For primary bibliographic entry see Field 5C.
W91-00491

CARCINOGENICITY OF CHLORINATED ACETIC ACIDS.
Health Effects Research Lab., Cincinnati, OH. Toxicology and Microbiology Div.
For primary bibliographic entry see Field 5C.
W91-00492

COMPARISON OF DRINKING WATER DISINFECTANTS USING MUTAGENICITY TESTING.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
W. B. Anderson, P. M. Huck, S. A. Daignault, G. A. Irvine, and D. W. Rector.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 201-225, 6 fig, 4 tab, 38 ref.

Descriptors: *Chlorination, *Disinfection, *Drinking water, *Mutagens, *Water pollution effects, *Water treatment, Ames test, Chloramination, Chloramines, Chlorine, Chlorine dioxide, Filtration, Granular activated carbon, Ozonation, Ozone.

Studies involving drinking water disinfectants have shown that chlorine produces high levels of mutagenic activity while chloramines and chlorine dioxide generally produce much less. Research was conducted using the Ames Salmonella typhimurium and yeast (Saccharomyces cerevisiae) mutagenic assays in parallel with chemical identification by gas chromatography/mass spectrometry (GC/MS), to assess the reaction products formed by the addition of the disinfectants chlorine, chloramine, chlorine dioxide, and ozone during drinking water treatment. Throughout the study, chlorination produced mutagenicity far more frequently in the Ames test than did chloramination, ozonation, or chlorine dioxide disinfection. Mutagenicity was observed occasionally in the chloramine post-filter. The chlorine dioxide post-filter position was examined and mutagenicity was never observed. Ozone was examined on five occasions and mutagenicity was observed once. Post granular activated carbon (GAC) disinfection with chlorine, chloramine, or chlorine dioxide did not produce mutagenicity in any of the salmonella strains examined, regardless of the oxidant which had been used prior to GAC. The results obtained with the Ames assay are generally consistent with the findings of other investigators, although some have reported mutagenicity following post GAC disinfection with chlorine, when chlorine or ozone were used as primary disinfectants. (See also W91-00476) (Lantz-PTT)
W91-00493

ORGANIC REACTIONS OF CHLORINE DIOXIDE IN DRINKING WATER-A MUTAGENIC ASSESSMENT.
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
R. Acha, E. Choshen, R. Bilts, M. Alburquerque, and N. Bass.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 227-238, 5 fig, 2 tab, 25 ref.

Descriptors: *Chemical reactions, *Chlorination, *Chlorine dioxide, *Disinfection, *Drinking water, *Mutagens, *Water pollution sources, *Water treatment, Ames test, Bacteria, Organic compounds, Oxidation, Potable water.

Chlorine dioxide (ClO_2) primarily reacts with organic model compounds, such as an electron transfer oxidant, with the formation of oxygenated products such as diols, aldehydes, ketones, and carboxylic acids. Some aldehydes have been shown to react with native DNA and are suspected carcinogens. Such compounds have not been found in potable water to date; however, it is possible that toxic aldehydes as well as other carcinogenic compounds are produced during the course of water disinfection. The objectives of this investigation were to determine whether ClO_2 disinfection produces unknown oxygenated products in drinking water, and to assess the possible mutagenic activity of disinfection products using the new Ames tester strain, TA104, which is particularly sensitive to oxidative mutagens. The quinones found as reaction products of ClO_2 in natural waters can be rationalized in view of the partially polyphenolic nature of the humic substances. Benzoquinone has been described as an inhibitor of bacterial growth, and some quinones were found to be cytotoxic and to interact with native DNA. This can explain the reduced number of revertants in both S. typhimurium strains found after ClO_2 treatment for both natural water and solutions of humic acid. The main finding of this study is that ClO_2 markedly decreases the number of revertants, either because of a decrease in mutagenicity or because of cytotoxic effects. (See also W91-00476) (Lantz-PTT)
W91-00494

MUTAGENIC ACTIVITY OF CONCENTRATED WATER EXTRACTS IN CULTURED MAMMALIAN CELLS AND DROSOPHILA MELANOGASTER.
Research Ltd., Ware (England). Genetic Toxicology Section.
For primary bibliographic entry see Field 5C.
W91-00495

EVALUATION OF PROTOCOL FOR PREPARING DRINKING WATER SAMPLES FOR AMES MUTAGENICITY TESTING.
California Dept. of Health Services, Berkeley.
For primary bibliographic entry see Field 5A.
W91-00496

TOXICOLOGICAL EFFECTS ASSOCIATED WITH DRINKING WATER DISINFECTANTS AND THEIR BY-PRODUCTS.
Dugway Proving Ground, UT.
For primary bibliographic entry see Field 5C.
W91-00497

ASSOCIATION BETWEEN CHLORINATED DRINKING WATER AND DECREASED SERUM HDLC IN TWO MONKEY SPECIES DURING DIETARY ATHEROGENIC STRESS.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W91-00498

EFFECTS OF DRINKING WATER CHLORINE ON HUMAN LIPID AND THYROID METABOLISM.
Cincinnati Univ., OH. Coll. of Medicine.
For primary bibliographic entry see Field 5C.
W91-00499

EFFECT OF DRINKING WATER CONTAINING CHLORINE AND MONOCHLORAMINE ON CHOLESTEROL AND TRIGLYCERIDE LEVELS IN THE LIVER OF THE PIGEON AND RABBIT.
Oak Ridge Research Inst., TN.
For primary bibliographic entry see Field 5C.
W91-00500

LONG-TERM EFFECTS OF CHLORINE-CONTAINING DISINFECTANTS ON PLASMA LEVELS OF CHOLESTEROL AND THYROXINE IN RABBITS AND PIGEONS.
Oak Ridge Research Inst., TN.
For primary bibliographic entry see Field 5C.
W91-00501

BIOCHEMICAL MECHANISMS OF IN VITRO CHLOROPROPANONE TOXICITY.
Health Effects Research Lab., Cincinnati, OH. Toxicology and Microbiology Div.
For primary bibliographic entry see Field 5C.
W91-00502

FISH HEPATOCYTE MODEL FOR INVESTIGATION OF THE EFFECTS OF TRIHALOMETHANES.
Environmental Research Lab., Narragansett, RI.
For primary bibliographic entry see Field 7B.
W91-00503

CHLORINE DIOXIDE DEPRESSES T3 UPTAKE AND DELAYS DEVELOPMENT OF LOCOMOTOR ACTIVITY IN YOUNG RATS.
Miami Univ., Oxford, OH. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-00504

REVIEW OF RECENT EPIDEMIOLOGICAL STUDIES REPORTING ASSOCIATIONS BETWEEN DRINKING WATER DISINFECTION AND CANCER.
Environmental Protection Agency, Cincinnati, OH.
P. A. Murphy, and G. F. Craun.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 361-372, 1 tab, 35 ref.

Descriptors: *Cancer, *Chlorination, *Epidemiology, *Literature review, *Public health, *Water pollution effects, *Water treatment, Disinfection, Human diseases.

The process of water disinfection creates a variety of potential exposures for the general public. Concern about the health problems created by these exposures has led to a research agenda that attempts to define exactly what these health risks are and the extent to which they might contribute to the overall cancer burden in the population. Analytical case control studies have shown a modest increase in the risk of bladder cancer and colon cancer in populations with relatively long-term exposure to chlorinated drinking water. Attributable fraction estimates indicate approximately 28% of nonsmoking, low risk bladder cancer cases in one study may be attributed to exposure to chlorinated drinking water if the association is known to be a causal one. This figure should be interpreted very cautiously because there is very likely a high degree of error associated with it, such as misclassification of exposure and confounding factors which may be responsible for different findings among epidemiological studies. The issue of whether a causal relationship exists between certain cancers and chlorinated drinking water exposure will not be decided easily and must await the results of several ongoing investigations in this area. (See also W91-00476) (Lantz-PTT)
W91-00505

CASE-CONTROL STUDY OF COLON CANCER AND VOLATILE ORGANICS IN WISCONSIN MUNICIPAL GROUNDWATER SUPPLIES.
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5C.
W91-00506

CASE-CONTROL STUDY OF MULTIPLE CANCER SITES AND WATER CHLORINATION IN IOWA.
Iowa Univ., Iowa City. Dept. of Preventive Medicine and Environmental Health.
For primary bibliographic entry see Field 5C.
W91-00507

CASE-CONTROL STUDY OF BLADDER CANCER IN MASSACHUSETTS AMONG POPULATIONS RECEIVING CHLORINATED AND CHLORAMINATED DRINKING WATER.
Brown Univ., Providence, RI. Dept. of Community Health.
For primary bibliographic entry see Field 5C.
W91-00508

BLADDER CANCER, TAP WATER CONSUMPTION, AND DRINKING WATER SOURCE.
National Cancer Inst., Bethesda, MD.
For primary bibliographic entry see Field 5C.
W91-00509

SERUM LIPID LEVELS IN NEIGHBORING COMMUNITIES WITH CHLORINATED AND NONCHLORINATED DRINKING WATER.
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5C.
W91-00510

DEVELOPMENT AND CALIBRATION OF A MODEL FOR PREDICTING OPTIMUM CHLORINATION SCENARIOS FOR BIOFOULING CONTROL.
Miami Univ., Coral Gables, FL. Dept. of Civil and Architectural Engineering.
For primary bibliographic entry see Field 5C.
W91-00516

MEASUREMENT OF CHLORINE RESIDUALS IN CHLORINATED COOLING WATERS: EFFECT OF ORGANIC NITROGEN.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00517

MANGANESE DEPOSITION IN CHLORINATED POWER PLANT COOLING WATER.
Public Service Electric and Gas Co., Newark, NJ.
R. Sugam, J. F. Garey, and J. M. White.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 545-554, 2 tab, 8 fig.

Descriptors: *Biofouling, *Chlorination, *Electric powerplants, *Manganese, *Scaling, *Water pollution effects, *Water treatment, Ammonia, Chlorine compounds, Cooling water, New Jersey, Salem.

Studies of biological fouling carried out at the Public Service Electric and Gas Company (PSE and G) Salem (New Jersey) Generating Station between 1984 and 1985 showed that continuous chlorination at a level of 0.3 to 0.5 ppm total residual chlorine (TRC) effectively controlled macrofouling in a mock-up of the plants service water system. However, this treatment promoted scale deposits of iron and manganese, which increased the risk of corrosion and an expected decline in heat exchanger efficiency. In 1986, follow-up studies based on our 1984-1985 findings were carried out at the Salem Station to explore the effects of several variables on scale deposition and to test some control methods. Preliminary results of this work (principally for manganese) are presented here. Manganese was deposited as a direct result of continuous chlorination. With no chlorination there was little deposition. Although previous macrofouling studies at the site indicated that intermittent chlorination caused deposition, it was evident only at very high TRC levels. Manganese scaling at the Salem site is a direct consequence of continuous chlorination of the source water. Monochloramine, produced in a reaction between abundant ammonia and free chlorine, prevented scale deposition over the duration of the tests in the season when they were conducted. Proprietary compounds tested were less effective. (See also W91-00476) (Lantz-PTT)
W91-00518

MICROBIOFOULING ON PLASTIC PACKING IN COOLING TOWERS: A CASE FOR CHLORINE TREATMENT.
Central Electricity Generating Board, Leatherhead (England). Technical Planning and Research Div.
J. W. Whitehouse, and J. Coughlan.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 555-563, 2 fig, 5 tab, 5 ref.

Descriptors: *Biofouling, *Chlorination, *Cooling towers, *Water treatment, Biological treatment, Chlorine, Plastics.

The buildup of fouling on cooling tower splash packs is limited by the relatively small surface area of the packs and by the incessant impact of water droplets. By contrast, the labyrinthine construction of the alternative film-forming type of pack encourages the growth of bacterial slimes and the codeposition of silt and scales. This leads to large increases in pack weight that can pose a threat to the structural integrity of the packs and its supports, and can also impair thermal performance. There are three interrelated problems here. Initially, the weight of the pack must be controlled to avoid damage to the packs and its supports. Second, there are indications from full size towers

that fouling build-up is reducing the predicted savings. Third, the only immediately available control strategy appears to be a resumption of biocide (specifically chlorine) dosing. Adoption of continuous low-level chlorination at prevailing demands resurrects problems of transport and storage and discharge to the waterway. If the rate of makeup were to be reduced by operating the cooling circuits at a higher CF, there would be a reduction in the input of sediment, nutrients and chlorine demand, and the volume of chlorinated water purged to the waterway also would be reduced. Comparisons of plastic tower packings from wastewater treatment plants show that while nutrient loading on the latter is far higher, overall weight gains are similar. (See also W91-00476) (Lantz-PTT)
W91-00519

TARGETED CHLORINATION SCHEDULES AND EFFECTS ON HEAT TRANSFER.
Stone and Webster Engineering Corp., Boston, MA.
Y. Mussalli, W. Chow, S. Sengupta, and T. Waite.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 565-576, 11 fig, 1 tab, 5 ref.

Descriptors: *Biofouling, *Chlorination, *Heat transfer, *Water treatment, Chlorine, Chlorine compounds, Condensers.

Biofouling is a major cause of reduced heat transfer in condensers: it leads to diminished plant performance and availability. Chlorination, the conventional method of biofouling control, has become less effective since the EPA lowered the allowable discharge concentrations of chlorine residuals to 0.2 mg/L total residual chlorine and restricted discharge to 2-hr/plant. The Electric Power Research Institute (EPRI) has sponsored research on a number of alternative biofouling control techniques. Targeted chlorination involves the application for short periods of time (10-15 min) of a high dose chlorine solution (1 to 5 ppm) to selected fractional areas of the inlet tube sheet of the condensor. The objectives of targeted chlorination are to: (1) use chlorine more efficiently; (2) improve the thermal performance of condensors; and (3) meet regulatory requirements for chlorine effluents. The preliminary targeted chlorination investigations sponsored by EPRI were successful in demonstrating effective chlorination schedules to maintain the cleanliness of condensor tubes. The chlorination predictive model can aid in minimizing chlorine use while achieving clean tubes and high heat transfer coefficients. The targeted chlorination schedules of 0.5 to 2 ppm require about 10 to 15 min duration and two applications per day. These schedules may require the chlorination of only two to six fractional sections of the tube sheet at a time and will result in only minor water box modifications. A full scale demonstration is being conducted at the Brayton Point Station Unit 2 Condensor to evaluate the effect of several targeted chlorination schedules on thermal performance. (See also W91-00476) (Lantz-PTT)
W91-00520

BY-PRODUCTS OF CHLORINATION AT TEN OPERATING UTILITIES.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W91-00521

ORGANIC HALIDE FORMATION DURING WATER TREATMENT UNDER FREE CHLORINE VERSUS CHLORAMINATION CONDITIONS.
Arizona Univ., Tucson. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00522

EFFECT OF PREOZONATION ON TRIHALOMETHANE AND TOTAL ORGANIC HALOGEN FORMATION AT THE LOUISVILLE WATER COMPANY.
Louisville Water Co., KY.
S. A. Hubbs, and J. C. Smith.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 623-631, 5 fig, 4 ref.

Descriptors: *Chlorination, *Louisville, *Ozonation, *Pretreatment of water, *Trihalomethanes, *Water pollution sources, *Water treatment, Chloramines, Halides, Kentucky.

One of the more promising treatment techniques investigated for trihalomethanes (THM) control used ozone as an oxidant prior to the application of free chlorine. This treatment process may be applicable where maintenance of a free chlorine residual is required by state regulating agencies. For the Louisville Water Company (LWC), the accomplishment of breakpoint chlorination has been required to minimize taste and odor problems resulting from subsequent oxidation with chlorine dioxide or chloramines. Data on the application of ozone prior to free chlorine were collected at a pilot plant scale for a range of raw water conditions at LWC, with the intention of evaluating how this combination of oxidants might work in the LWC disinfection process. The use of ozonation prior to chlorination might be effective in a treatment scheme incorporating conventional coagulation and sedimentation, ozonation with the appropriate reaction time (20 min), free chlorination with an appropriate reaction time (30 min), ammoniation and pH adjustment from 8.0 to 8.5 for the formation of chloramines and corrosion control, and conventional filtration. Such a treatment scheme at LWC might be expected to reduce total THM (TTHM) and total organic halide levels in the distribution system by about 50% as compared with a similar treatment scheme without ozonation. For conditions experienced at LWC, the resultant TTHM levels would be expected to fall in the range of 10 to 15 micrograms/L as an annual average. (See also W91-00476) (Lantz-PTT)
W91-00523

TRIHALOMETHANE FORMATION POTENTIAL AND ORGANIC CONTENT: A NEW ANALYTICAL APPROACH.
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
A. Bruchet, C. Anselme, J. P. Duguet, and J. Mallevialle.
Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 633-648, 14 fig, 17 ref.

Descriptors: *Chemical reactions, *Chlorination, *Humic acids, *Pollutant identification, *Trihalomethanes, *Water pollution sources, *Water treatment, Lignin, Organic carbon, Pyrolysis, Tannins.

Studies have shown that chlorination by-products are widespread throughout the world and that polyhydroxyaromatic structures present in humic substances are probably the main trihalomethane (THM) precursors. The concentration of THMs formed during chlorination has been correlated with various nonspecific parameters such as raw water dissolved organic carbon (DOC), UV absorbance, and chlorine demand. A method based on a degradative technique, pyrolysis-gas chromatography/mass spectrometry (GC/MS), was developed to further understanding of the relationship between THM formation potential (THMFP) and DOC. This method was applied to various standard compounds such as lignins, tannins, and humic substances, and to several selected waters, to characterize the THMFP of the waters as a function of their macromolecular content. Investigation of several high-molecular weight substances in groundwater and surface waters has shown an important variation in their THMFP. The use of a degradative technique, pyrolysis-GC/MS, has revealed the capability to precisely determine the organic content of the samples, thus leading to a better understanding of THM precursors. It is also possible to determine the approximate proportion of the different types of biological macromolecules, such as polyhydroxyaromatics, carbohydrates (neutral sugars and N-acetylaminosugars), and peptidic material. Using this method, a good relationship was found between the THMFP, the origin, and the macromolecular content of various waters. (See also W91-00476) (Lantz-PTT)
W91-00524

CHLOROFORM FORMATION BY THE TRANSFER OF ACTIVE CHLORINE FROM MONOCHLORAMINE TO PHLOROACETOPHENONE.
RPC Environmental Management, Inc., Chicago, IL.
For primary bibliographic entry see Field 5B.
W91-00525

TRIHALOMETHANE FORMATION AND DISTRIBUTION IN BROMIDE-RICH AND AMMONIA-CONTAINING LAKE WATER.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00526

CHLORINATION OF SURFACE WATERS: EFFECTS OF BROMIDE CONCENTRATION ON THE CHLOROPICRIN FORMATION POTENTIAL.
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5B.
W91-00527

CORRELATIONS BETWEEN MEASUREMENTS OF ORGANIC HALIDE AND SPECIFIC HALOGENATED VOLATILE ORGANIC COMPOUNDS IN CONTAMINATED GROUNDWATER.
Arizona Univ., Tucson. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00528

EFFECTS OF COPPER (II) ON THE PRODUCTION OF TRIHALOMETHANES IN MODEL AND NATURAL WATERS.
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
For primary bibliographic entry see Field 5B.
W91-00529

DEVELOPMENT OF CHLORINE DEMAND KINETICS IN A DRINKING WATER TREATMENT PLANT.
Compagnie Generale des Eaux, Paris (France).
C. Ventresque, G. Bablon, B. Legube, A. Hecart, and M. Dore.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 715-728, 8 fig, 6 tab, 28 ref.

Descriptors: *Chlorination, *Chlorine, *Drinking water, *Kinetics, *Water treatment, Chemical reactions, Filtration, France, Odors, Potable water, Seine River, Taste, Total organic carbon.

Numerous researchers have identified and quantified several haloorganics including trihalomethanes (THMs), chloroacetic acids, dihaloacetonitriles, and chloroaromatic acids. Extensive studies have shown that this type of organic compound accounts for only 50% of the total organic halogens (TOX) in chlorinated humic solutions. Chloro-

phenols have long been known as precursors to an unpleasant taste in chlorinated drinking water. However, the identities of other chlorination by-products responsible for tastes and odors are generally not well known. The general purpose of this study is to try to identify the organic components (that react with chlorine) of the Seine River water coming to the final treatment step at the Choisy-le-Roi potable waterworks near Paris. Chlorine consumption kinetics are presented from samples of water taken after sand filtration and ozone/granular activated carbon filtration treatment steps, and of treated water after laboratory ultrafiltration. The kinetics profiles of treated drinking water (before and after ultrafiltration) indicates that the initial chlorine demand (after 4-h of chlorination) of disturbed water was 0.6-1.0 mg/L (initial dosage of 2 mg Cl2 per mg total organic carbon (TOC), with TOC = 2 mg/L). The long-term chlorine demand of distributed water was interpreted in terms of second order kinetic constants (k = 0.1/M/s) and the potential for long-term chlorine demand (b = 2.5 to 4.5 X 0.00010 mol/L. The initial chlorine demands and the kinetic constants of ozone/GAC-treated waters were always lower than those obtained from sand-filtered water, demonstrating the well known effect of activated carbon on the removal of organic matter. (See also W91-00476) (Lantz-PTT)
W91-00530

FURTHER STUDIES OF HYPOCHLORITE ION PAIR CHEMISTRY AND DISINFECTION EFFICIENCY.
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. Haas, C. D. Trivedi, and J. R. O'Donnell.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 729-740, 5 fig, 2 tab, 15 ref.

Descriptors: *Chemical reactions, *Chlorination, *Disinfection, *Hypochlorite, *Water treatment, Anions, Cations, Chlorine, Ion transport.

Previous studies have shown that lithium, sodium and potassium cations can form ion pairs with hypochlorite that are titratable potentiometrically, and that enhance the disinfection efficiency of free chlorine to coliforms. A report on investigations that were conducted to measure the ion pair formation using a different experimental methodology and to determine whether enhancement of biocidal efficiency by ion pairs would also occur when ammonia was present, (thus resulting in a stable combined residual) is presented. The effect of ionic environment on the spectrophotometric absorbance of hypochlorite anion was used to study the chemistry of ion pairing. Escherichia coli was used in the disinfection microbiology studies. Results indicate that the alkali cations (lithium, sodium, and potassium) produce measureable changes in the physical-chemical properties of hypochlorite consistent with the formation of a 1:1 ion pair with the hypochlorite anion. The dissociation constants measured spectrophotometrically are somewhat greater than those previously obtained from titration. Data obtained in this work suggest that the ion-pairing phenomenon may also influence the reaction rate with ammonia, and that there may be some nonadditivity of the inactivation rates of free chlorine and monochloramine during dynamic chlorination. (See also W91-00476) (Lantz-PTT)
W91-00531

INFLUENCE OF ORGANIC NITROGEN COMPOUNDS ON THE PRODUCTION OF ORGANOCHLORINE COMPOUNDS IN THE CHLORINATION OF HUMIC MATERIAL.
Technische Hogeschool Delft (Netherlands). Lab. for Analytical Chemistry.
E. de Leer, C. Erkelens, and L. de Galan.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 763-781, 10 fig, 5 tab, 20 ref.

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Nitrogen compounds, *Water pollution sources, *Water treatment, Amino acids, Chemical reactions, Chloroform, Humic acids.

The production of chloroform in the chlorination of humic acid is strongly influenced by the presence of nitrogen compounds. Compounds with free amino groups, such as primary amines and amino acids, react preferentially with chlorine almost completely suppress the production of chloroform until the breakpoint reaction. Less reactive nitrogen compounds, such as urea and uracil, show no marked influence when low amounts of chlorine are added. However, they do suppress chloroform production at higher chlorine concentrations, due to oxidation reactions. The chlorination of humic materials is known to give several by-products that cannot be explained on the basis of aromatic-type precursors, such as resorcinol derivatives. Amino acids, purine, or pyrimidine residues, which form an integral part of the humic acid structure, may explain the production of chlorinated compounds such as di-chloropropanedioic acid and 2,2-dichlorobutanedioic acid. (See also W91-00476) (Lantz-PTT)
W91-00534

INACTIVATION OF E. COLI SUSPENSION BY CHLORINE: IMPLICATION OF CHLORINATION OF ALPHA-AMINO ACIDS AND URACIL.
Ecole Nationale Superieure de Chimie de Rennes (France). Lab. de Chimie des Nuisances et Genie de l'Environnement.
H. L. Benabdesselam, J. Poncin, and G. Martin.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 783-794, 6 fig, 2 tab, 16 ref.

Descriptors: *Amino acids, *Chlorination, *Escherichia coli, *Uracil, *Water treatment, Bacteria, Bacterial physiology, Chloramines, Disinfection.

During water chlorination, different substances can react with oxidizing agents, especially nitrogenic substances. Free chlorine reacts rapidly with ammonia to generate gas phase chloramines and nitrogen. With some aliphatic amino acids, the effect of chlorine is known to lead to the formation of aldehydes and nitriles. The very presence of several chlorine derivatives in drinking water shows the existence of several other possible reactions with other substances. This work describes experiments in chlorination of a suspension of E. coli under conditions comparable with those used for water disinfection with chlorine. The phenomenon of cell membrane permeability alteration of inactivated bacteria is apparently enhanced by exposure to chlorine. Exposure of E. coli to chlorine results in the leakage of substances such as amino acids, uracil and phosphates. The large presence of phosphates in the membrane led the authors to theorize that the bacteria have been actually damaged, and that such damage causes leakage of internal constituents of the cell. The nitro-organic substances ejected by bacteria are quickly eliminated by reaction with free chlorine. Thus, schemes or reactive mechanisms of the chlorination process are suggested. (See also W91-00476) (Lantz-PTT)
W91-00535

CHLORINE AND MONOCHLORAMINE MEASUREMENTS USING A PULSED SILVER IODIDE ELECTRODE.
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-00536

CHLORAMINE INTERFERENCE IN THE MEASUREMENT OF FREE CHLORINE BY THE AMPEROMETRIC MEMBRANE ELECTRODE.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W91-00537

CHLORINATED ORGANIC BY-PRODUCTS OF THE REACTION OF N-CHLOROPIPERIDINE WITH STOMACH FLUID FROM LABORATORY ANIMALS.
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
For primary bibliographic entry see Field 5B.
W91-00538

SOME PHYSICAL AND CHEMICAL CHARACTERISTICS OF AN UNIDENTIFIED PRODUCT OF INORGANIC CHLORAMINE DECOMPOSITION.
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
R. L. Valentine, and G. G. Wilber.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 819-832, 9 fig, 2 tab, 11 ref.

Descriptors: *Chloramines, *Chlorination, *Path of pollutants, *Water pollution sources, *Water treatment, Chemical analysis, Chemical properties, Chemical reactions, Chlorides, Chlorine, Physical properties, Polarity, Pollutant identification.

Chloramine solutions are inherently unstable at neutral pH and slowly decompose via a complex series of chlorine transfer and redox reactions, ultimately leading to the oxidation of ammonia-nitrogen and reduction of chlorine to chloride. Several studies have reported spectrophotometric evidence of the formation of another unknown product. The product, which exhibits a peak absorbance near 240 nm, has been shown to accumulate as chloramine species decompose. This study was undertaken to further characterize some physical and chemical properties of the unidentified species that may be of value in helping to isolate and identify its structure, and in determining its significance and fate under conditions encountered during water treatment. The unidentified product is very polar and ionic, since it could not be extracted into several common organic solvents. The species does not appear to be a cation. Its reactivity with activated carbon and two common amine based anion resins suggests that it may be reactive toward organic compounds found in drinking water. The equivalent absorptivity values indicate that the unidentified product was a minor product relative to nitrogen gas and chloride ion in these studies. (See also W91-00476) (Lantz-PTT)
W91-00539

CHEMISTRY OF BROMINE TRANSFER: DISPROPORTIONATION AND HYDROLYSIS IN BROMAMINE SYSTEMS.
Hartford Univ., West Hartford, CT. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W91-00540

PROPOSED MECHANISM FOR THE REACTIONS OF CHLORINE DIOXIDE WITH AQUATIC ORGANIC MATERIALS.
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
R. Acha, E. Choshen, R. Blits, and O. Grafstein.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 849-857, 5 fig, 2 tab, 21 ref.

Descriptors: *Chemical reactions, *Chlorine dioxide, *Organic matter, *Path of pollutants, *Water treatment, Alkenes, Chlorination, Chlorine, Disin-

fection, Drinking water, Hydrocarbons, Olefins, Styrene.

Chlorine dioxide is becoming a viable alternative to chlorine for disinfecting drinking water and for the treatment of effluents. One of the main reasons for this is that it does not produce trihalomethanes and that it produces much smaller amounts of chlorinated compounds. It is clear that being an active chemical, chlorine dioxide may react with aquatic organic materials to produce other products of a largely unknown nature. A better understanding of the mechanisms by which ClO2 reacts may provide an important basis for the prediction of it's by-products and their health effects. It is quite natural that radical mechanisms have been postulated for the reactions of ClO2 with various hydrocarbons in light of its electronic structure and odd number of electrons. Thus, its reactions with alkenes possessing allylic hydrogens have been viewed as proceeding via the abstraction of allylic hydrogen. Styrene clearly reacts with ClO2 by an electron transfer process. However, the question still exists about whether other olefins possessing allylic hydrogens will also react by a similar pathway, or whether they might also react by a hydrogen abstraction process. Indene and allylbenzene that contain very active allelic (or benzoic) hydrogens react similarly to styrene. Reactivities of various alkenes with ClO2 correlate with their ionization potentials. The order of reactivities of the various olefins with ClO2 is at variance with either the radical mechanism or the hydrogen abstraction process. A regular acid-catalyzed addition reaction is also very unlikely. (See also W91-00476) (Lantz-PTT)
W91-00541

HYDROLYSIS CONSTANTS OF CHLORINE MONOXIDE AND BROMINE CHLORIDE IN WATER.
Stanford Univ., CA.
For primary bibliographic entry see Field 5B.
W91-00542

OZONATION OF ALACHLOR: EFFECTS AND SUITABILITY AS A TREATMENT TECHNOLOGY.
F. L. Mink, and J. R. Rickabaugh.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 871-882, 8 fig, 1 tab, 4 ref.

Descriptors: *Alachlor, *Chemical reactions, *Ozonation, *Water treatment, Disinfection, Herbicides, Ozone, Toxicity.

Alachlor (2-chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl) acetamide) is a widely used preemergence herbicide. Concern has been shown by the EPA because alachlor has been found in ground and surface waters in concentrations > 100 ppm. A study was initiated to determine the mechanism and suitability of ozonation of alachlor as a treatment technology. Reports have shown a high destruction rate of alachlor by ozone, but the by-product formation and mechanism rate of this reaction (or reactions) was previously uninvestigated. One major stable reaction product was formed upon ozonation of alachlor (> 100 ppb). The reaction itself is rapid (<2.5-15 min) and driven to a low rate of completion depending on concentration (8-10%). The methoxyl group of the methoxymethyl moiety on alachlor can act as an electron-donating group. Ozone can act as a nucleophilic agent. Ozone rapidly attacks the more negative pole of terminal hydrogens of the methoxymethyl group on alachlor and replaces the hydrogens with oxygen molecules. Carbon-hydrogen bonds have been shown to be susceptible to attack by ozone. Alachlor was oxidized by ozone dehydrogenation of the N-methyl group. The drawback of alachlor ozonation is the production of a by-product of unknown toxicity at higher levels (0.100 ppb). Since these levels are rarely if ever encountered in environmental samples (natural groundwater and surface waters) this is of little concern. Ozone at reasonable contact times and low doses is an efficient treatment technology for the removal of alachlor from drinking water. (See also W91-00476) (Lantz-PTT)
W91-00543

FACTORS THAT CHANGE BACTERIAL RESISTANCE TO DISINFECTION.
California Univ., Irvine.
B. H. Olson, and M. Stewart.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 885-904, 6 fig, 8 tab, 44 ref.

Descriptors: *Bacteria, *Bacterial physiology, *Disinfection, *Microbiological studies, *Water treatment, Biological studies, Growth, Nutrients.

Data is presented in this paper from previously published and current research suggesting that a number of factors influence an organism's susceptibility to a disinfectant. These factors include: differential disinfection resistance; distribution in the water; differential genera response; environmental strain variation; growth condition effects; nutrient effects of noncarbon constituents; and selection for disinfection resistance. Primary among these is the organism's ability to withstand exposure to disinfection. This is mediated through physiological changes in the organism itself or through its association with physical factors in the environment that enhance survival. The data generated to date indicate that this is a complex set of interacting variables that will require detailed experimentation before complete understanding is achieved. Currently, better laboratory models can be developed by testing organisms from a variety of environments or hosts as opposed to relying on one test strain. Testing those organisms that grow outside the host after exposure to nutrient conditions will provide bacterial tolerance to disinfection more closely resembling that occurring in water distribution systems. (See also W91-00476) (Lantz-PTT)
W91-00544

DISINFECTION OF BACTERIAL BIOFILMS.
American Water Works Service Co., Inc., Belleville, IL. Belleville Lab.
M. W. LeChevallier.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 905-915, 5 fig, 2 tab, 27 ref.

Descriptors: *Bacteria, *Biofilms, *Disinfection, *Water treatment, Chloramines, Chlorine, Hypochlorous acid.

An investigation was conducted in order to examine the disinfection of biofilm bacteria and to characterize the interaction of biocides with microbial interfaces. The results suggest that penetration of the disinfectant to the biofilm surface may be a major rate limiting step. Data indicated that monochloramine, despite being a weaker disinfectant, was better able to penetrate and inactivate biofilms growing on a variety of surfaces. The attachment of bacteria to surfaces interferes with disinfection efficiency; ie., attachment of bacteria to a glass surface decreased the disinfection efficiency of free chlorine over 75 fold. Complex biofilms also decreased free chlorine disinfection efficiency by more than 600 fold. Of the compounds tested, monochloramine showed the greatest ability to penetrate and inactivate biofilm bacteria. For biofilm grown on granular activated carbon, 1 mg/L monochloramine showed the same disinfection efficiency as 1 mg/L hypochlorous acid. Additional research is necessary to model the interaction of disinfectants with microbial biofilms. (See also W91-00476) (Lantz-PTT)
W91-00545

NEW HALAMINE WATER DISINFECTANTS.
Auburn Univ., AL. Dept. of Chemistry.
S. D. Worley, D. E. Williams, S. B. Barnela, and L. J. Swango.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 931-942, 7 fig, 1 tab, 14 ref. Army Medical Research and Development Command Contract DAMD 17-82-C-2257.

Descriptors: *Disinfection, *Halamines, *Wastewater treatment, *Water treatment, Bromine, Bromine compounds, Chlorine, Chlorine compounds, Organic compounds, Potable water.

The evaluation of three new N-halamine biocides in the imidazolidinone class is reported. These biocides were recently synthesized and are more stable and efficacious as disinfectants than are their oxazolidinone counterparts. It is expected that they will receive considerable attention in the commercial sector in the near future. The three new N-halamine disinfectants are: Compound A (1,3-dichloro-4,4,5,5-tetramethyl-2-imidazolidinone); Compound AB (1,3-dibromo-4,4,5,5-tetramethyl-2-imidazolidinone) and; Compound ABC (1-bromo-3-chloro-4,4,5,5-tetramethyl-2-imidazolidinone).
There are a number of possible applications for the new N-halamine disinfectants. Compound A could be used in applications for which long-term disinfection is required, but contact time is relatively unimportant (e.g., cooling towers, air conditioning systems, and swimming pool winterization). It could also be used in hot tubs because of its great stability at elevated temperatures. Compound AB would be useful in applications requiring fairly rapid disinfection with more stability than afforded by free chlorine or free bromine (potable water in remote locations). Compound ABC may be the most useful of the new compounds because the bromine moiety causes rapid disinfection, while the chlorine moiety contributes long-term disinfection. All of the new compounds are considerably less corrosive than free halogen toward materials. It should be emphasized that toxicology testing has not been completed for the new compounds, but is in progress in the industrial sector. (See also W91-00476) (Lantz-PTT)
W91-00547

WATER CHLORINATION: IS THERE ENVIRONMENTAL RISK.
Virginia Inst. of Marine Science, Gloucester Point.
M. H. Roberts.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 969-970.

Descriptors: *Chlorination, *Water pollution effects, *Water treatment, Aquatic environment, Chlorine, Disinfection, Environmental effects.

Awareness of chlorination as a significant environmental problem has led to better control of chlorination, to a considerable degree abating, though certainly not eliminating, acute environmental impacts. Clearly, there are complex chlorination by-products that are not removed by dechlorination. Nevertheless, while the biological significance of these compounds at ambient concentrations is unknown, no research is being funded to fill this data gap. The detection limit for chlorine residuals remains essentially unchanged over the past decade. Chronic exposure to low-level residual or by-product concentrations never received much attention, largely because of limitations in analytical chemistry. During the period that interest in environmental impacts of chlorine residuals has declined, there have been two significant findings that have focused attention on other chlorine-related issues: first, efforts to identify chlorination by-products led to the discovery of a variety of exotic reactive chemical species that might be expected to have ominous human health impacts; second, a relationship has been established between the incidence of

certain cancers and use of chlorinated drinking water. Research work is still needed in at least three areas: (1) To determine whether there are any significant effects of highly reactive compounds such as MX on individual aquatic organisms, and whether these compounds pose a threat to aquatic communities; (2) To determine whether by-products of chlorination, such as MX, accumulate in food chains, eventually reaching man; and (3) What type, if any, tumerogenic impacts exist against fish exposed to chlorination by-products. (See also W91-00476) (Lantz-PTT)
W91-00550

MICROBIOLOGICAL PERSPECTIVE ON RISKS FROM WATER CHLORINATION.
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 971-972, 1 tab, 5 ref.

Descriptors: *Chlorination, *Microbiology, *Water pollution effects, *Water treatment, Disinfection, Human diseases, Potable water, Public health, Water quality.

It is apparent that some risks, particularly from carcinogenicity of chlorine and/or its by-products, exist. However, it is important that environmental professionals not lose sight of the potential risks for increase in infectious disease if, in the process of 'optimizing' chlorination practice, the microbial quality of finished potable water supplies is allowed to deteriorate. Waterborne disease outbreaks arise through a variety of causes, including insufficient treatment other than disinfection. For example, inadequate filtration was one cause for a waterborne outbreak of rotavirus in Colorado. Similarly, cross-connections, possibly coupled with inadequate disinfection residuals at the consumer's tap, may have been responsible for a massive waterborne outbreak of Norwalk Agent in Georgia. Even at present, the risk of cancer from chlorine by-products may balance out the risks from disease associated with waterborne pathogens. For example, assuming that 15% of the bladder cancers in the United States may be attributable to water chlorination, an annual mortality rate of about 0.65/100,000 can be computed. On the other hand, the overall mortality from intestinal infectious diseases, meningitis, and hepatitis A is about 0.5/100,000 per year. There are also a substantial number of illnesses from reportable diseases that might plausibly arise from a variety of exposures, including drinking water. However, the fraction of the deaths and illnesses that may be attributable to drinking water exposure is uncertain at present. (See also W91-00476) (Lantz-PTT)
W91-00551

REMOVAL OF DBCP (1,2-DIBROMO-3-CHLOROPROPANE) FROM GROUNDWATER. VOLUME 1. POE/POU (POINT OF ENTRY/POINT OF USE) TREATMENT DEVICES INSTITUTIONAL AND JURISDICTIONAL FACTORS.
California State Univ., Fresno.
K. E. Longley, G. P. Hanna, and B. H. Gump.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-198808. Price codes: A07 in paper copy, A01 in microfiche. Report No. EPA/600/2-89/029, June 1989. 51p, 14 fig, 2 tab, 18 ref, 3 append. EPA Cooperative Agreement CR-812227.

Descriptors: *Granular activated carbon, *Water quality management, *Water treatment, Drinking water, Filters, Filtration, Institutional constraints, Maintenance, Monitoring, Performance evaluation, Potable water, Quality control, Water quality.

The results obtained from evaluating ten granular activated carbon (GAC) point-of-entry (POE) devices show that while these GAC units generally function satisfactorily, their performance can change markedly over short periods of time. These results require conscientious, periodic monitoring. This monitoring appears to be a significant shortcoming in the application of this technology. During the course of the study, operation and maintenance problems were encountered with three of the ten units monitored. A potential health risk exists for those individuals who unwittingly drink contaminated water that is inadequately treated using point-of-entry/point-of-use (POE/POU) technology due to monitoring or operation and maintenance shortfalls. A third party evaluation of POE/POU treatment equipment to verify the manufacturers' claims is an important mechanism for providing consumer protection. Such an equipment testing program could be established by legislation and implemented through a state laboratory. Or, one or more independent testing facilities could be designated by the state and financed by fees from equipment vendors who wish to market their products within the state certification of specific types of POE/POU Treatment Devices that can have an adverse effect on consumer health if they do not function properly. (Lantz-PTT)
W91-00558

POINT-OF-ENTRY DRINKING WATER TREATMENT SYSTEMS FOR SUPERFUND APPLICATIONS.
PEI Associates, Inc., Cincinnati, OH.
C. D. Chambers, and T. A. Janszen.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-195010. Price codes: A05 in paper copy, A01 in microfiche. Report No. EPA/600/2-89/027, June 1989. 69p, 4 fig, 5 tab, 8 ref, 3 append. EPA Contract No. 68-03-3413.

Descriptors: *Drinking water, *Point-of-entry water treatment, *Potable water, *Superfund, *Water treatment, Air stripping, Filtration, Granular activated carbon, Maintenance, Monitoring, Performance evaluation.

The EPA and State Superfund agencies need a technical assistance manual to assist their personnel in the selection of an effective drinking water treatment system for individual households in areas where the drinking water has been adversely affected by superfund site contaminants, and no other alternative water supply is available or feasible. Commercially available water treatment systems for individual households are of two basic types: (1) point-of-use (POU) and point-of-entry (POE). A POU device consists of equipment applied to selected water taps to reduce contaminants at each tap. A POE device consists of equipment to reduce the contaminants in the water distributed throughout the entire structure of a house. This study was initiated to collect monitoring, operation and maintenance, performance and design data on existing Superfund POE water treatment systems. Evaluation of the collected data showed that the existing data are not sufficient for the preparation of a technical assistance document to meet the objectives of EPA and State Superfund personnel. Therefore, additional studies are needed to develop the technical assistance document. Because most of the existing data and field experience related to POE water treatment is concerned with granular activated carbon filters and air strippers for the treatment of organic contaminants, further detailed study should center around these two technologies. (Author's abstract)
W91-00572

REDUCTION OF PHOSPHORUS AND CHLOROPHYLL A CONCENTRATIONS FOLLOWING CACO3 AND CA(OH)2 ADDITIONS TO HYPEREUTROPHIC FIGURE EIGHT LAKE, ALBERTA, CANADA.
Alberta Univ., Edmonton. Dept. of Zoology.
E. E. Prepas, T. P. Murphy, J. M. Crosby, D. T. Walty, and J. T. Lim.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1252-1258, August 1990. 8 fig, 3 tab, 43 ref.

Descriptors: *Algal control, *Calcium, *Chlorophyll a, *Eutrophic lakes, *Figure Eight Lake, *Lake restoration, *Liming, *Phosphorus removal, *Water quality control, Canada, Chemical treatment, In situ treatment, Limiting nutrients, Phytoplankton.

Lime (CaCO3 or Ca(OH)2) was added a total of four times to hard-water, hypereutrophic, Figure Eight Lake, Alberta, Canada. Within 14 days of treatment, chlorophyll a concentrations (Chla) decreased to less than half the values measured just prior to treatment; there was no short-term trend in total phosphorus concentrations, (P) sub T. Chla returned to pretreatment concentrations within 35 days of treatment. Although dissolved oxygen concentrations were very low in the autumn and first winter following lime treatments, under-ice (P) sub T were less than half pretreatment values. During the summer following the first lime treatments, under-ice (P) sub T, (Chla), and water clarity improved relative to the other five summers on record; average (P) sub T decreased to 30% and (Chla) decreased to 12% of the previous summer's values. The following winter, dissolved oxygen depletion rates were 59% of pretreatment rates. The short-term reduction in (Chla) was likely related to precipitation of growth-limiting nutrients other than phosphorus, such as iron, with the calcite. In contrast, improvements in (Chla) the year following the first lime treatments could be related to lower (P) sub T in the water column, as a consequence of increased P-binding capacity of bottom sediments. Lime treatments can enhance water quality in eutrophic hard-water lakes by suppression of growth-limiting nutrients for phytoplankton. (Author's abstract)
W91-00625

EMERGING ISSUES FOR THE MICROBIOLOGY OF DRINKING WATER.
University of South Florida, Tampa. Dept. of Environmental and Occupational Health.
J. B. Rose.
Water Engineering and Management WENMD2, Vol. 137, No. 7, p 23-26,29, July 1990. 3 tab, 5 ref.

Descriptors: *Disinfection, *Drinking water, *Microorganisms, *Pathogenic bacteria, *Viruses, *Water quality control, *Water treatment, Biofilms, Diseases, Giardia, Heterotrophic bacteria, Legionella, Protozoa.

In order to achieve the quality of drinking water at the tap which is now expected--and mandated by law--microbial issues will have to be addressed. A better understanding of microbiology of drinking water will lead to appropriate treatment approaches for maintaining and improving water quality. Since 1970 common waterborne diseases such as cholera and typhoid have been adequately controlled in the US; however, newly recognized waterborne agents have emerged. Between 1970 and 1985, 52% of the outbreaks were due to Giardia, whereas 38% were an unidentified acute gastrointestinal illness. Cryptosporidium is another new enteric protozoan disease of concern. Recent outbreaks and their causes and future prevention are discussed in this article. Enteric viruses, another major cause of waterborne disease, were first isolated from sewage. These include polioviruses, coxsackieviruses and echoviruses. Besides the enteric organisms, a naturally occurring aquatic bacterium, Legionella pneumophila has been responsible for major outbreaks of disease in the US. Factors involving their growth and contamination of water systems are detailed. Other organisms able to grow in water supply distribution systems are heterotrophic plate count bacteria, commonly used as an indicator of water treatment and water quality. These HPC bacteria are associated not only with opportunistic infections but are partly responsible for biofilm development within the distribution systems. There are a number of drinking water treatment rules which have been or will be promulgated by the EPA which are partly directed at the microbial quality of drinking water. These include the 'Surface Water Treatment Rule' to control Giardia, the 'Ground Water Disinfection Rule' mandating disinfection of groundwaters to control viruses and the 'Disinfection By-Products Rule' aimed at decreasing the potential cancer risks from compounds produced during the disinfection process. This risk must be balanced with

the risk of microbial pathogens from inadequate disinfection. (VerNooy-PTT)
W91-00627

REDUCING MAINTENANCE IN A WATER TREATMENT PLANT.
Denver Water Dept., CO.
J. Swenson.
Water Engineering and Management WENMD2, Vol. 137, No. 7, p 34-35, July 1990.

Descriptors: *Construction materials, *Corrosion control, *Maintenance, *Plastics, *Sedimentation basins, *Wastewater facilities, *Water treatment facilities, Denver, Flytes, Friction, Mechanical equipment, Underwater.

In 1988, the Denver Water Department expanded and upgraded its Marston Treatment Plant to increase finished treated water production. The new facility, treating 220 million gallons per day, includes six flocculation and sedimentation basins. In each of the sedimentation bays, long fiberglass scraper blades (flytes) move along on railroad rails imbedded in the concrete floor. A system of plastic chain and sprockets move the flytes. Use of special industrial-grade ultra-high molecular weight (UHMW) plastic is enabling maintenance to be cut to a minimum. Industrial-grade UHMW plastic is used to create a system of plastic on plastic, acting as an interface between blades and the steel rails. This reduces the coefficient of friction when wet to 0.05 (versus 0.30 to 0.40 for steel on steel), thus requiring less energy to move the entire system. The plastic wear rails are shaped to allow for expansion of the steel underneath, providing a flexible joint to prevent any buckling and to prevent the flytes from hanging up as they pass over. (VerNooy-PTT)
W91-00629

MICROCOMPUTER ANALYSIS OF PIPE NETWORKS.
Broward County Office of Environmental Services, Pompano Beach, FL. Wastewater Management Div.
J. M. Chansler, and D. R. Rowe.
Water Engineering and Management WENMD2, Vol. 137, No. 7, p 36,38-39, July 1990. 2 tab, 8 ref.

Descriptors: *Computer models, *Computer-aided design, *Microcomputers, *Network design, *Pipes, *Water conveyance, Model testing, Water demand.

Today most water distribution systems are designed and analyzed by using computer programs. In the design of a water distribution system, consideration must be given to several factors, including average daily per capita water consumption, city size, presence of industries, water quality, cost of water, climate, population characteristics and whether the water supply is metered. The hydraulic computations involved in designing a water distribution system can only be approximated, as it is impossible to consider all the factors affecting loss of head in a complicated network of pipes. Here a computer program using the Hardy Cross method of network analysis is considered; it is compared to conventional analysis used in the past. The program is presented on a demonstration disk and is limited to no more than 10 pipes, 8 nodes, and 4 loops. Three textbook examples are illustrated for a 1, 2, and 3-loop water distribution system. The microcomputer and conventional solutions are compared, and agreement was very good. For an example of an actual field situation, the demonstration disk was used to evaluate modifications to a water distribution system in Bowling Green, KY. The 5-pipe, 5-node single loop system was evaluated under average water consumption conditions. The microcomputer program is a powerful tool that can be used to analyze water distribution systems. This particular program can be used as a simple tool for solving day-to-day problems in network analysis. Much larger programs are available for more extensive analyses. (VerNooy-PTT)
W91-00630

EFFICACY OF A SMALL-QUANTITY WATER TREATMENT METHOD FOR INACTIVATING GIARDIA CYSTS IN RAW WATER.
Research Inst. for Diseases in a Tropical Environment, Congella (South Africa).
H. D. Hamilton, and T. F. H. G. Jackson.
Water SA WASADV, Vol. 16, No. 3, p 201-204, July 1990. 1 tab, 22 ref.

Descriptors: *Chlorination, *Clarification, *Disinfection, *Giardia, *Raw water, *Water treatment, Chemical treatment, Flocculation, Performance evaluation, Temperature effects.

Chlorfloc is a commercial product developed for clarifying and disinfecting small quantities of raw water. It consists of a mixture of sodium dichloros-triazinetrione dihydrate as a source of chlorine for disinfection and a proprietary flocculant to clarify raw water. The efficacy of the disinfecting process was investigated with regard to Giardia muris cysts. The ability of viable G. muris trophozoites to excyst under defined conditions was used as the criterion for viability before and after treatment. Experiments were performed using artificially polluted water at 25, 15, 10 and 5 C. In each of these temperature regimens, the time and dosage required to effect a 99.9% reduction in the number of viable cysts was determined. At 25 C one tablet/L was effective after 7 minutes, whereas at 15 and 10 C the exposure time had to be extended to 15 minutes. At 5 C, two tablets/L and a 15 minutes exposure time were required. Results of this study indicate that the Chlorofloc treatment process is highly effective in disinfecting Giardia cysts in a high demand water over a wide range of temperatures. It would be a useful water treatment aid to rural communities as well to the military forces and the weekend hiker. (Author's abstract)
W91-00637

USE OF UV RADIATION FOR DISINFECTING WATER IN FIRST STAGE GROWTH TANKS STOCKED WITH RAINBOW TROUT LARVAE (ZASTOSOWANIE PROMIENIOWANIA UV DO DEZYNFEKCJI WODY W PODCHOWALNI WYLEGU PSTRAGA).
Instytut Rybactwa Srodladowego, Piaseczno (Poland). Zaklad Rybactwa Stawowego.
For primary bibliographic entry see Field 8I.
W91-00786

IMPLICATIONS OF HEAVY METAL TOXICITY RELATED TO EDTA EXPOSURE.
Bundesgesundheitsamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W91-00792

EXPERIMENTAL INVESTIGATION OF SIZE DISTRIBUTION OF SUSPENDED PARTICLES IN GRANULAR BED FILTRATION.
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
S. Vigneswaran, J. S. Change, and J. G. Janssens.
Water Research WATRAG, Vol. 24, No. 7, p 927-930, July 1990. 4 fig, 2 tab, 4 ref.

Descriptors: *Filters, *Filtration, *Granular bed filtration, *Particle size, Experimental design, Filter media, Pollen, Sand filters, Suspended solids, Water treatment.

Although from observation and theory, it has been found that the size of suspended particles is one of the most important physical variables influencing deep bed filtration, size is not often measured because the techniques available are time consuming and expensive. Laboratory-scale experimental studies were conducted to show the effect of size distribution of particles in granular bed filtration. Detailed experiments were conducted with pollen grain particles of two and three different sizes in suspension with sand as the filter medium. The results showed that the investigation of granular bed filtration based merely on the mean size is inadequate as particles of different size have different removal efficiencies. It was also shown that there is an improvement in fine particle removal efficiency when they are present with particles in polydispersed suspension. The improvement was greater when the ratio of coarse particles to fine particles increased. Improvement was greater when the size of the coarse particles increased. (Author's abstract)
W91-00819

N-CARBOXYMETHYLCHITOSAN: ALGISTATIC AND ALGICIDAL PROPERTIES.
Prairie View A and M Univ., TX.
R. G. Cuero, and E. B. Lillehoj.
Biotechnology Techniques BTECE6, Vol. 4, No. 4, p 275-280, July/August 1990. 2 fig, 2 tab, 11 ref.

Descriptors: *Algal control, *Algicides, *Chitin, *Cyanophyta, *Water treatment, Biomass, Dose-response relationships, Microscopic analysis, N-carboxymethylchitosan, Nuisance algae.

Anabaena (Cyanophyceae) are among the most common algae in fresh water environments such as swimming pools, aqueducts, sewages and natural water sources. Algae in aqueous environments modify the environment by their growth and metabolite production and can produce undesirable consequences. A water soluble agent made from waste crustacean shells that controls the growth of algal cells was identified. Growth of an Anabaena species was inhibited in the presence of 12 to 39 nM N-carboxymethylchitosan (NCMC) as determined by the reduction of algal biomass and chlorophyll production. Application of dilute water solutions of NCMC prevented algal multiplication, enhanced aggregation of cells and assured clearing of algal suspensions by filtration. A potential role for NCMC in algal control strategies is suggested. (MacKeen-PTT)
W91-00837

INCIDENCE OF BDELLOVIBRIO SPP. IN MAN-MADE WATER SYSTEMS: COEXISTENCE WITH LEGIONELLAS.
Newcastle Public Health Laboratory, Institute of Pathology, General Hospital, Westgate Road, Newcastle upon Tyne NE4 6BE, United Kingdom.
I. R. Richardson.
Journal of Applied Bacteriology JABAA4, Vol. 69, No. 1, p 134-140, July 1990. 1 fig, 3 tab, 34 ref.

Descriptors: *Legionella, *Microbiological studies, *Public health, *Vibrio, *Water conveyance, Bdellovibrios, Laboratory methods, Microorganisms, Pathogenic bacteria, Water distribution.

Bdellovibrios have been isolated from surface waters but there are no reports of its occurrence in main water supplies. One hundred and thirty five water samples from 81 sources were examined for the presence of Bdellovibrio bacteriovorus and Legionella species. Bdellovibrios were isolated by a double-layer agar technique with two strains of Legionella pneumophila serogroup I as the host organisms. Bdellovibrio species were isolated from 57.8% and Legionella species from 9.5% of the samples. The two species occurred together in 4.4% of samples. The incidence of Bdellovibrio species and its occurrence with legionellas in man-made water systems may have several explanations. As Bdellovibrios are ubiquitous in aquatic environments and natural soils they may, like legionellas, be transferred to these systems by mains water and aerosol. The role bdellovibrios play in the reduction or removal of Legionella species from water systems is difficult to assess. Although it is unlikely that bdellovibrios could be actively used in control of Legionella species, they may act as natural inhibitors to multiplication in man-made water systems. (Author's abstract)
W91-00876

5G. Water Quality Control

INPUT AND DEPLETION OF WOODY DEBRIS IN ALASKA STREAMS AND IMPLICATIONS FOR STREAMSIDE MANAGEMENT.
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
For primary bibliographic entry see Field 4C.
W91-00011

IMPLICATIONS OF ENVIRONMENTAL PROGRAM PLANNING FOR SITING A NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN, NEVADA, USA.
Department of Energy, Carson City, NV. Nevada Nuclear Waste Project Office.
For primary bibliographic entry see Field 5E.
W91-00026

LATERALLY AVERAGED HYDRODYNAMICS MODEL FOR RESERVOIR PREDICTIONS.
Toronto Univ. (Ontario). Dept. of Physics.
For primary bibliographic entry see Field 2H.
W91-00062

TARGETING REMEDIAL MEASURES TO CONTROL NONPOINT SOURCE POLLUTION.
Guelph Univ. (Ontario). School of Engineering.
W. T. Dickinson, R. P. Rudra, and G. J. Wall.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 499-507, June 1990. 4 fig, 3 tab, 34 ref.

Descriptors: *Agricultural watersheds, *Erosion control, *Model studies, *Nonpoint pollution sources, *Sediment control, *Soil erosion, *Water pollution control, Cropland, Ontario, Sediment yield, Soil management.

The watershed model GAMES was used for the evaluation of a targeting approach to control fluvial sedimentation arising from soil erosion in agricultural areas. The data considered for the analysis consists of output from the application of the model to existing and hypothetical soil and crop management systems in two small watersheds of southern Ontario, one in the rolling uplands and the other in a very flat lowland area. The model output includes estimates of spring sediment yield from field-size cells to the stream outlet for existing agricultural management conditions, and estimates of sediment yield resulting from the successive implementation of two levels of soil erosion controls under four remedial measures strategies. The results reveal that, for the rolling upland watershed exhibiting a wide range of soil erosion and sediment yield rates, targeted control programs can be expected to provide an extremely effective approach to sediment control. For flat lowland watersheds, exhibiting relatively uniform soil erosion and sediment yield rates, the strategy of targeting controls may be somewhat more effective than a random approach to control, but not as efficient as in the case of watersheds in more rolling terrain. The study shows that a screening model such as GAMES provides a very useful tool for the planning and evaluation of erosion and sediment control programs. (Author's abstract)
W91-00090

TREATMENT OPTIONS FOR WATER SUPPLIES CONTAMINATED WITH DBCP AND OTHER PESTICIDES.
Brown and Caldwell, Walnut Creek, CA.
For primary bibliographic entry see Field 5F.
W91-00103

USE OF STATISTICAL METHODS IN INDUSTRIAL WATER POLLUTION CONTROL REGULATIONS IN THE UNITED STATES.
Environmental Protection Agency, Washington, DC.
H. D. Kahn, and M. B. Rubin.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 129-148, November 1989. 7 fig, 3 tab, 5 ref.

Descriptors: *Compliance, *Environmental protection, *Industrial wastewater, *Statistical analysis, *Statistical methods, *Water pollution control, Pollution load, Regulations, Statistics, Wastewater disposal, Water pollution sources.

The process of developing regulations to limit the discharge of pollutants from industrial sources includes studies and surveys of the industry to define products, processes, wastewater sources and characteristics, and appropriate subcategorization and control technologies in use. Developing effluent limitations is accomplished by first identifying and characterizing the various industrial point source categories. Limitations on the amount of pollutants that may be discharged in treated wastewater are based on the statistical analysis of physical and chemical analytical data characterizing the performance capability of technologies currently in use. Pollutants regulated include conventional pollutants such as biochemical oxygen demand and pH, toxic pollutants identified on the priority pollutant list, and nonconventional pollutants such as radioactivity, color, and chemicals not on the priority pollutant list. Effluent limitations are numerical values which act as boundaries on measures that indicate how well an industrial process is operating. The statistical procedures used to determine limitations involve the fitting of effluent data to distributions and the use of estimated upper percentiles of the distributions as the basis of the limitations. In the majority of cases, the lognormal distribution, or a straightforward extension of the lognormal distribution, provides a reasonable fit to effluent data. The determination of regulatory discharge limitations, based on estimates of percentiles of lognormal distributions of measured pollutant concentrations in treated wastewater, has resulted in the formalization of engineering 'rules of thumb' into variability factors determined from ratios of high effluent to average levels. Regulatory efforts then rely on statistical measures such as daily maximum and maximum monthly averages. Modifications are made to account for different averaging periods and detection limit observations. (Tappert-PTT)
W91-00125

CONTINUOUS EFFLUENT CONSENTS: MODELLING AND COMPLIANCE TESTING.
WRc Engineering, Swindon (England).
R. W. Crabtree, C. P. Crockett, and J. C. Ellis.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 149-164, November 1989. 8 fig, 5 tab, 13 ref.

Descriptors: *Compliance, *England, *Environmental protection, *Frequency distribution, *Industrial wastewater, *Regulations, *Statistical analysis, *Water pollution control, Legal aspects, Probabilistic process, Statistical methods, Statistics, Wastewater disposal, Water pollution sources.

The control of continuous polluting discharges in the U.K. was placed in a framework of statistically based legislation nearly 10 years ago. Both discharge standards and desired river quality class objectives are assessed within a probabilistic system of pollution control, whereby a minimum level of 95 percent compliance with standards has to be achieved. The use of such a statistical framework permits occasional infringements of what would otherwise be fixed standards. The change to a statistically based system has been a slow process carried out in stages; (1) the introduction of a river quality classification; (2) setting long-term river quality objectives; (3) setting discharge consents to achieve these objectives; and (4) monitoring compliance with the consents and objectives. A pass-fail compliance monitoring scheme has been implemented, which utilizes a non-parametric benefit-of-doubt approach. Several catchment-scale consent setting models were utilized to simulate the probability distribution of stream quality parameters and the interaction between several significant polluting discharges. One fundamental component of these models was the choice of a suitable probability distribution to describe the various model inputs in terms of flow and quantity. Different parameters require different parametric distributions to achieve an acceptable data fit, and in some cases, such as chloride, a non-parametric fit was most appropriate. The use of the wrong distribution to estimate the 95th percentile can lead to large errors. While current efforts at compliance monitoring focus on the catchment basin level, a national approach is likely to be devised for procedures such as setting discharge consents and assessing compliance. (Tappert-PTT)
W91-00126

AUDITING THE QUALITY OF EFFLUENT DISCHARGES.
Anglian Water Authority, Peterborough (England).
A. E. Warn.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 165-181, November 1989. 2 fig, 5 tab, 7 ref, 2 append.

Descriptors: *Compliance, *Environmental protection, *Industrial wastewater, *Monitoring, *Statistical analysis, *Wastewater disposal, *Water pollution control, England, Probabilistic process, Regulations, Sampling, Statistical methods, Statistics.

For many rivers, the achievement of good water quality is a matter of regulating the discharges from wastewater treatment plants. The effective audit of the quality of such discharges is a good basis for measuring progress in controlling pollution. To prove that control is effective, the techniques which underpin the following tasks must be sound and consistent: (1) the standards for rivers must be devised so that the environmental objectives are met with the required reliability. The form of the standards will be constrained by the procedures available to monitor compliance; (2) the standards worked out for effluents must have the correct mathematical relation with the river targets, and must be consistent with the options available for auditing performance; (3) the assessment of compliance must be objective; and (4) the statistics used to summarize the performance of a region must be simple, stable, clear, and consistent with the results for individual sites. Sampling procedures and statistical analysis of sample data is critical to monitoring effluent quality. Concepts such as the Pessimistic Confidence Limit, Optimistic Confidence Limit, Confidence of Failure, and Confidence of Compliance statistics are used to help guide regulatory actions based upon effluent test results. (Tappert-PTT)
W91-00127

SOME COMMENTS ON ANALYSIS TECHNIQUES FOR CENSORED WATER QUALITY DATA.
Waterloo Univ. (Ontario). Dept. of Health Studies.
V. T. Farewell.
Environmental Monitoring and Assessment EMASDH, Vol. 13, No. 2/3, p 285-294, November 1989. 2 fig, 3 tab, 8 ref.

Descriptors: *Monitoring, *Statistical analysis, *Statistical methods, *Water quality, Comparison studies, Data interpretation, Niagara River, Statistics, Trace levels, Water quality control, Water quality management.

When investigating trace substances in ambient water, a proportion of water sample concentrations is usually below the limits of detection. In medical and industrial reliability studies, comparisons are often made of time to event data, which includes right censored observations indicating only that an observation is greater than a specified value. Non-parametric procedures, widely used in the analysis of time to event data, can be applied to water quality data which is left censored. A non-parametric estimate of the cumulative distribution function for left censored water quality data can be generated quite easily. For the comparison of levels of trace substances it is necessary to combine an unconditioned likelihood for the proportion of observations below a detection limit with a partial likelihood for the proportion of the distribution above the detection limit, in order to make use of regression methodology. Levels of toxic substances at the head and mouth of the Niagara River can be compared using a model that corresponds to a Lehmann family of distributions. When comparisons are based on matched pair data, further modifications are necessary. A model can developed that parallels that for time to event data, and consideration is also given to model extensions which allow for a dependence between observations at the same location over a period of time. Other non-parametric methodologies may also be appropriate. (Author's abstract)
W91-00131

STATUS OF THE NIAGARA RIVER POINT SOURCE DISCHARGE INFORMATION: SAMPLING DESIGN AND ESTIMATION OF LOADING.
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W91-00134

MEASURES OF FLOW VARIABILITY FOR GREAT LAKES TRIBUTARIES.
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
For primary bibliographic entry see Field 2E.
W91-00136

ROBUST GRAPHICAL METHODS FOR DIAGNOSING TREND IN IRREGULARLY SPACED WATER QUALITY TIME SERIES.
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
For primary bibliographic entry see Field 5B.
W91-00138

DEVELOPMENT OF A SOFTWARE PACKAGE FOR TREND DETECTION IN TEMPORAL SERIES: APPLICATION TO WATER AND INDUSTRIAL EFFLUENT QUALITY DATA FOR THE ST. LAWRENCE RIVER.
INRS-Eau, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W91-00139

WATER AND NITROGEN MANAGEMENT IN CENTRAL PLATTE VALLEY OF NEBRASKA.
Nebraska Univ., Clay Center. South Central Research and Extension Center.
For primary bibliographic entry see Field 3F.
W91-00173

STREAMFLOW SIMULATION USING DETERMINISTIC MODEL.
Dames and Moore, Park Ridge, IL.
For primary bibliographic entry see Field 2E.
W91-00174

RAINFALL-REAERATION EFFECTS.
Florida Inst. of Tech., Melbourne. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 2A.
W91-00175

GROUND-WATER-MANAGEMENT AREAS IN UNITED STATES.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 4B.
W91-00182

TWO-STAGE GROUND-WATER REMEDIATION DESIGN.
Connecticut Univ., Storrs. Environmental Research Inst.
D. Ahlfeld.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 517-529, July/August 1990. 5 fig, 2 tab, 15 ref.

Descriptors: *Economic aspects, *Groundwater pollution, *Model studies, *Site remediation, *Water pollution treatment, Design criteria, Groundwater management, Hydraulic engineering, Numerical analysis, Optimization, Pumping.

Although available technology may be inadequate for the complete remediation of certain contaminated groundwater sites, hydraulic control can be used to reduce the extent of, and contain, groundwater contaminants until adequate technology can be developed. The design of such a remediation system can be viewed as a two-stage process. A first stage is the achievement of a reduction of the extent of the contaminant, and a second stage is the maintenance of the contaminant at this reduced areal extent. Viewed in this light, alternative pump staging criteria can be considered within the design process. These criteria can include allowing the well location and pumping rate to change during the remediation effort. The economic significance of incorporating increasing complexity of pumpstage criteria into the design process was conducted using numerical simulation and a new multistage optimization formulation. The analysis concludes that while different pumping strategies should be used in each stage of remediation, it is generally unnecessary to consider the impact of the pumping strategy in the first stage on the remediation cost in the second stage. (Author's abstract)
W91-00184

FIVE WORST SUPERFUND DESIGN MISTAKES.
Geraghty and Miller, Inc., Tampa, FL.
E. K. Nyer.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 76-81, Summer 1990. 1 fig, 2 tab.

Descriptors: *Cleanup operations, *Design standards, *Superfund, *Water pollution treatment, Groundwater management, Groundwater pollution, Iron, Performance evaluation, Wells.

Criticism of the Superfund program has been leveled by both congressional and press sources. The opinion has been expressed that the main problem with the Superfund program is that it has been inadequate in educating the public as to what can be accomplished and in what time frame. The five worst Superfund project designs encountered in reviewing Superfund projects are: (1) a contaminated well clean-up site where lack of experienced personnel to review that data forced a relatively simple treatment system to be designed as a complicated, expensive system; (2) a case of iron removal from groundwater where improper laboratory analysis of water samples was performed and the lack of experience of EPA reviewers to understand the significance of these errors resulted in design flaws; (3) a case of improper modeling of flow selection where a lack of knowledge of new technology also contributed to a too-costly system; and, (4) another iron-removal project where lack of practical experience by designers led to a high cost solution where less expensive methodologies were available. These design mistakes were ultimately due to the system by which the low-bid contractor was given design responsibility. This led to less experienced personnel including recent college graduates being used on these contracts. Experienced designers should be used in all final process design and review of projects to in order to avoid mistakes such as those discussed here. (Hoskin-PTT)
W91-00363

HIGH WATER LEVEL INSTALLATION OF MONITORING WELLS FOR UNDERGROUND STORAGE TANKS.
C. Treadway.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 82-83, Summer 1990. 2 fig.

Descriptors: *Groundwater level, *Groundwater pollution, *Monitoring, *Monitoring wells, *Underground storage, *Water pollution prevention, Drilling, Florida, Oil, Storage tanks.

Most states throughout the United States have guidelines and requirements concerning the installation of monitoring wells. The most common monitoring well installation would perhaps be for the detection of fuel leaking from an underground storage tank. The 'ideal' geological formation to detect leakage from an underground storage fuel tank through a monitoring well system would have a water table below the bottom of the tank and a confining layer within the next 10 to 20 feet. The standard monitoring well construction method in this case would be to auger down using a 4 1/4-inch I.D. hollow-stem auger to some point above the confining layer but more than 5 feet below the water table. A 2-inch inside diameter screen and riser is placed inside the hollow-stem augers. The screen would be placed to allow at least 2 feet above the high water table 5 feet or more below the low water table. In areas such as Central Florida, where water tables are high, heaving sands become the driller's enemy. Area hydrological conditions can call for special drilling techniques to handle difficult formations such as the heaving sands. The first and probably most important item is to keep a head of water on the formation, reducing the tendency of sand to run into the augers. Drillers should be careful not to overdrill the hole. If a contract calls for sampling through the augers using split spoons, special care must be taken to avoid sand running up the augers when pulling the split spoons. A problem facing drillers in high water areas is meeting state guidelines for vadose zone monitoring in well construction. Obtaining samples through the pumping of the sample well may also be complicated under high groundwater levels. (Hoskin-PTT)
W91-00364

TRANSPORT OF LOW-CONCENTRATION CONTAMINANTS IN SATURATED EARTHEN BARRIERS.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W91-00372

DISTRIBUTIONS AND POPULATION STRUCTURES OF TWO INTERTIDAL ESTUARINE POLYCHAETES IN THE LOWER ST. LAWRENCE ESTUARY, WITH SPECIAL REFERENCE TO ENVIRONMENTAL FACTORS.
Quebec Univ., Rimouski. Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W91-00383

BIOREMEDIATION COMES OF AGE.
Bioscience Management, Inc., Bethlehem, PA.
T. G. Zitrides.
Pollution Engineering PLENBW, Vol. 22, No. 5, p 57-62, May 1990.

Descriptors: *Bioremediation, *Cleanup operations, *Hazardous wastes, *Toxic wastes, *Waste treatment, *Water pollution prevention, *Water pollution treatment, Aerobic bacteria, Anaerobic bacteria, Bacteria, Biodegradation, Groundwater pollution, Organic wastes, Process control, Site remediation, Sludge treatment, Soil treatment.

Bioremediation offers a cost-effective technology to rectify hazardous waste sites. The acceptance of bioremediation by industry in the United States and in the European Economic Community has been due to its relatively low cost compared to incineration or safe landfilling, its effectiveness in dealing with a wide variety of organic compounds, and its provision of a final, ecologically sound solution to toxic waste problems. Bioremediation began at least 20 years ago with the relatively haphazard application of bacterial strains originally developed for the production of enzymes used in detergents. The selection of a bioremediation method is governed by the local situation, contaminant type, concentration and location within the site. Three general bioremediation techniques are in use today: biostimulation, used primarily for cleanup of contaminated groundwaters and soils; bioslurry, used for sludges and highly contaminated soils; and biofarming, applied to lightly contaminated soils, usually less than 1% organics. The development of rapid techniques for determining biokinetics as a function of substrate, such as electrolytic respirometry, has turned bioremediation from an art into a science. The future offers the application of biodegradation to a wider range of materials as new strains of microorganisms, both aerobic and anaerobic, are developed. (MacKeen-PTT)
W91-00400

CHANNEL CHANGES AT CROSS SECTIONS OF THE POWDER RIVER BETWEEN MOORHEAD AND BROADUS, MONTANA, 1975-88.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2J.
W91-00436

SUPERFUND RECORD OF DECISION: VELSICOL CHEMICAL CORPORATION, IL.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-196703/AS. Price codes: A05 in paper copy, A01 in microfiche. Report No. EPA/ROD/R05-88/081, September 1988. 98p, 3 fig, 5 tab.

Descriptors: *Administrative decisions, *Illinois, *Site remediation, *Superfund sites, *Volatile organic compounds, *Water pollution treatment, Costs, Injection wells, Land disposal, Soil contamination, Velsicol Chemical Corporation Site.

The Velsicol Chemical Corporation (VCC) is a manufacturing facility located in east-central Illinois, approximately one mile north of the City of Marshall, Clark County, Illinois. The site is bordered by a railroad on the south and by an unnamed tributary on the southwest. A total of 334 acres onsite are leased for crop farming. VCC was in operation between the mid-1930s and August 1987, and occupied an area of approximately 420 acres, 172 of which were used for production or disposal practices for petroleum derivatives including resins, solvents, and pesticides, including chlordane manufacturing. All process wastewater has been deep-well injected onsite since 1965 and the majority of the waste solids and sludges generated at the facility were disposed of in Pond 5/6 until 1980 when the firm ceased operations. Accidental and intentional offsite releases of wastes were noted during the period the ponds were in operation. In the 1980s, all contaminated soil and visually contaminated sediments were consolidated and stabilized with cement and fly ash, and covered with a temporary clay cap and vegetation. The primary contaminants of concern affecting the soil, sediments, surface water and groundwater are VOCs including benzene and other organics including PAHs and pesticides. The selected remedial action for this site includes: excavation of 10,200 sq yd of contaminated stream and pond sediments and 87,900 sq yd of contaminated soil and backfilling with clay, and revegetation; and consolidation of all excavated material onsite with in-place stabilization followed by construction of a RCRA cap; construction of groundwater collection drain with disposal via onsite deep well injection or treatment using granular activated carbon prior to offsite discharge; groundwater and surface monitoring; and implementation of land use and deed restrictions. The estimated present worth cost for this remedial action including O&M is $9,080,910. (Author's abstract)
W91-00445

SUPERFUND RECORD OF DECISION: INDEPENDENT NAIL, SC.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-209829/AS. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R04-88/040, August 1988. 69p, 4 fig, 4 tab.

Descriptors: *Administrative decisions, *Metal-finishing wastes, *Site remediation, *South Carolina, *Superfund sites, Endangered species, Groundwater quality, Independent Nail Site, Infiltration, Wastewater lagoons.

The Independent Nail site, occupying 24.6 acres, is located near the town of Beaufort, South Carolina. The site is surrounded by fields, woodlands, and wetlands. The United States Fish and Wildlife Service in 1987 indicated that endangered and threatened species may exist in the area of influence of the site, however, these species have not been confirmed to be inhabiting areas that may be impacted by the operations at the site. An estimated 25 residents live within one quarter mile of the site. The Black & Johnson Company, previous owners of the site, manufactured metallic screws and fasteners. As part of the manufacturing process, the company discharged approximately 33,000 gal/day of plating wastewater into a unlined infiltration lagoon. The discharge rate may have been as high as 75,000 gal/day. The lagoon was in use from approximately 1969 to 1980. The South Carolina Department of Health and Environmental Control reported that wastewater contained some organic cleaning solvents and metals. In April 1980, the Black & Johnson Company ceased operation. Two months later, the Independent Nail Company purchased the plant and currently operates a panelling-nail coating process, but does not discharge wastewater to the lagoon. The first remedial action at this site addressed the contaminants in the soil and lagoon sediments. This remedial action at this site addresses groundwater contamination. The primary contaminants of concern include chromium, zinc, and cyanide. The selected remedial action for this site addressing groundwater is a no action remedy. The source control remedial action conducted at the site was determined to have little or no impact on groundwater quality in the area of the site. This remedial action has no costs associated with it. (Author's abstract)
W91-00446

SUPERFUND RECORD OF DECISION: FRENCH LIMITED, TX.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-204788/AS. Price codes: A05 in paper copy, A01 in microfiche. Report No. EPA/ROD/R06-88-030, March 1988. 96p, 4 fig, 7 tab.

Descriptors: *Administrative decisions, *Cleanup, *Groundwater pollution, *Site remediation, *Superfund sites, *Texas, *Water pollution treatment, Costs, Flooding, French Limited Site, Industrial wastes, Wastewater lagoons.

The French Limited, Inc. (FLI) site, a 22.5-acre tract of land, is located in Harris County, Texas. The site is situated one mile east of the San Jacinto River. The entire site is within the 100-year flood plain of the River and has flooded frequently in the past. Between 1966 and 1972, approximately 300,000 sq yd of industrial wastes from area petrochemical companies were deposited in an unlined 7.3-acre pit, formerly an active sand pit. The disposal site operated under a temporary permit issued by the Texas Water Quality Board. In 1973, the permit was revoked after extensive public hearings and legal proceedings, and FLI was ordered to cease operations. As part of the settlement, FLI was ordered to remove all the structures, tankage, and process equipment. The tract of land was ultimately deeded to the State. During a flood event, the dike surrounding the waste pit was overtopped and breached, and contaminated sludges were discharged into an adjacent slough. In 1982, the U.S. EPA conducted an Immediate Removal Action (IRA). The dike was repaired and the majority of discharged sludges were pumped back into the pit. The floating portion of the sludges was removed and disposed of in July of 1983 during another U.S. EPA IRA. Groundwater has been heavily contaminated by the leaching action of organic wastes deposited in the pit. Sludge and soil from the waste pit and adjacent slough include the following primary contaminants: PCBs, PCP, organics, VOCs, metals, and arsenic. The selected remedial action for this site includes: in-situ biodegradation of sludges and contaminated soils with aeration of the lagoon waste for degradation enhancement; stabilization of residues followed by onsite disposal; groundwater pumping and treatment; surface water discharge to the San Jacinto River with treatment, as necessary; backfilling of the lagoons to grade and contour; and groundwater monitoring. The estimated present worth for this remedial action is $47,000,000. (Author's abstract)
W91-00447

SUPERFUND RECORD OF DECISION: BEACHWOOD/BERKELEY, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-189484/AS. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/ROD/R02-88/062, June 1988. 45p.

Descriptors: *Administrative decisions, *Drinking water, *Lead, *New Jersey, *Superfund sites, Beachwood/Berkeley Site, Groundwater quality, Plumbing, State jurisdiction, Wells.

The Beachwood/Berkeley Well site, encompasses Beachwood Borough and Berkeley Township in central-east Ocean City, NJ. The total population of the two municipalities is approximately 23,000. In response to a public complaint of possible aluminum contamination of drinking water, the New Jersey Department of Environmental Protection (NJDEP) sampled four potable wells and discovered the presence of lead in exceedance of the Federal Interim Primary Drinking Water Standard. Subsequent sampling confirmed the presence of lead at approximately 4 times the standard. The Ocean County Health Department, collected additional samples in the two municipalities. Results of analyses indicated that 15% of the total wells sampled in the Borough and 3% of the residential wells sampled in the Township exceeded the regulatory standard for lead in drinking water, however, there was no distinct geographical pattern to the occurrence of the lead contamination. By order of the NJDEP, an alternate supply of water was provided to the affected residents. After extensive investigation of lead levels in residential tap water, surface water, groundwater, sediments, soil, and lead concentrations in, and dissolution from plumbing systems, it was concluded that elevated concentrations of lead in drinking water were not caused by man-made or industrial sources. Rather, the sources of lead include; a minor contribution from native area groundwater, lead packers used in well construction, and dissolution of lead from lead-bearing materials of home plumbing systems, particularly lead/tin solder. Remediation under the Superfund program of the documented existence of lead in drinking water is precluded by law. The State of New Jersey is proceeding independently of Federal Superfund financing to address the presence of and the problems posed by lead in drinking water. (Author's abstract)
W91-00451

METHOD FOR DETERMINING THE COMPLETENESS OF DECHLORINATION WITH SULFITE.
Maryland Univ., College Park. Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W91-00532

FIVE YEAR PROGRAM STRATEGY FOR THE GREAT LAKES NATIONAL PROGRAM OFFICE, FY 1989-1993.
Environmental Protection Agency, Chicago, IL. Great Lakes National Program Office.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-206023. Price codes: A05 in paper copy, A01 in microfiche. Report No. EPA/905/9-89/001, GLNPO-89/1, December 1988. 84p, 6 fig, 4 tab.

Descriptors: *Great Lakes National Program, *Regulations, *Water quality, Ecosystems, Environmental protection, Federal jurisdiction, Great Lakes, Management planning, Project planning, State jurisdiction, Water quality control, Water quality management.

A five year strategy for the EPA's Great Lakes National Program Office (GLNPO) has two principle purposes: (1) to inform other EPA programs, Federal agencies, the Great Lakes States, and the public of GLNPO's goals and how they will be addressed; and (2) To provide a long term strategic framework for GLNPO, within which annual budget and workplan priorities can be established. Chapter one provides an overview of the Great Lakes Program office and its role in relation to the governmental organizations that influence environmental management decisions within the Great Lakes Basin, both in the US and Canada. Chapter two provides an overview of the great lakes ecosystem. Chapter three describes water quality problems within the Great Lakes Basin. Chapter four summarizes Federal and State environmental programs that work in the Great Lakes Basin with

a review of significant accomplishments. Chapter five describes the 1987 amendments to the Clean Water Act that define GLNPO's statutory charter to coordinate the US response to the Great Lakes Water Quality Agreement. Chapter six provides an overview of the Great Lakes Water Quality Agreement. Chapter seven presents GLNPO's five year strategy for addressing the priorities defined in the Agreement and for fulfilling its statutory mandate. (Lantz-PTT)
W91-00552

MOSES LAKE CLEAN LAKE PROJECT. FINAL STAGE 3 REPORT.
R. C. Bain.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-209126. Price codes: A16 in paper copy, A01 in microfiche. May 1987. 363p, 47 fig, 30 tab, 15 append.

Descriptors: *Algal blooms, *Eutrophication, *Lake restoration, *Moses Lake, *Water pollution control, *Water pollution sources, *Water quality, Agricultural runoff, Irrigation practices, Nonpoint pollution sources, Nutrients, Washington, Water quality control, Water quality management.

The Moses Lake Clean Lake Project represents a five year effort designed to identify and control nonpoint pollution sources affecting Moses Lake water quality. Moses Lake is a large freshwater lake located near the geographic center of Washington State. The lake is shallow and over-fertilized with nutrients from an extensive watershed encompassing over 1.5 million acres, and from urban development around the lake, and has experienced extensive blue-green algae blooms for over two decades, resulting in a diminished recreational use of the lake. Although a dilution program was successful in reducing algal blooms, it was also desirable to reduce the nutrient load entering the lake. In March 1982, a grant was obtained to conduct an investigation of agricultural and other nutrient sources in the Moses Lake watershed and the potential impact of these sources on Moses Lake water quality. The project was carried out in three stages: the stage one goal was to determine sources of nutrients within the Moses Lake watershed; stage 2 involved development of demonstrations of the best agricultural management processes and water quality control plans for implementation of stage 3; stage 3 emphasized implementation of a major agricultural cost share program that upgraded irrigation systems in the project area and off-farm projects involving urban wastewater disposal and construction of detention pond structures. (Lantz-PTT)
W91-00554

SUPERFUND RECORD OF DECISION, BRODERICK WOOD PRODUCTS COMPANY.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-188742. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/ROD/RO8-88/021, June 30, 1988. 116p 10 fig, 7 tab.

Descriptors: *Broderick Wood Products, *Cleanup operations, *Colorado, *Superfund, *Waste disposal, *Water pollution sources, Adsorption, Evapotranspiration, Incineration, Industrial wastes, Monitoring, Sludge, Soil contamination, Wastewater treatment.

Between 1947 and 1981, Broderick Wood Products operated a wood treatment facility in Adams County, CO, to treat power poles, fence posts, railroad ties and other wood products. Process wastes from the plant were conveyed through a clay pipe to two onsite, unlined surface impoundments, referred to as the main and secondary impoundments, located in the northwest corner of the facility. Records indicate that waste seepage was apparent just north of the site and became so extensive that the waste was burned off, starting in 1955. Site investigations conducted by the EPA in April 1981, and July 1982 noted several violations of Resource Conservation and Recovery Act requirements. Another site inspection in December 1982 revealed the possibility of serious contamination at a trench in the vicinity of the surface impoundments that reportedly had only been used for the disposal of solid waste. Wood treating chemicals were detected in a groundwater monitoring well located immediately downgradient of the surface impoundments. The main and secondary impoundments have been identified as the major sources of site contamination. The selected remedial action for this site includes: installation of access restrictions, excavation and onsite mobile incineration of the sludge and oil in the main and secondary impoundments, with offsite disposal of the residual ash; treatment of contaminated impoundment wastewater using carbon adsorption with disposal through onsite evapotranspiration or use as incinerator quench water; and excavation of the visibly contaminated soil beneath the impoundments, and onsite incineration if the volume is < 2500 cu yd, or onsite storage for further studies. (Lantz-PTT)
W91-00555

SUPERFUND RECORD OF DECISION MIDWEST MANUFACTURING, IO.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-188726. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/RO7-88/019, September 30, 1988. 62p, 4 fig, 7 tab.

Descriptors: *Cleanup operations, *Iowa, *Metal-finishing wastes, *Midwest Manufacturing Site, *Superfund, *Water pollution sources, Cadmium, Cyanide, Excavation, Heavy metals, Management planning, Soil contamination, Surface runoff, Vegetation, Waste disposal.

The North Farm operable unit is one of two subsites of the Midwest Manufacturing site located in a rural area east of Kellogg, Jasper County, Iowa. The subsite consists of an unlined disposal cell containing approximately 200 cubic yards of soil contaminated with electroplating wastes. The disposal cell is located on the lower slope of a rolling hill adjacent to the valley of Bear Creek, which is an intermittent stream located 500 feet east and 50 feet lower than the site. Records indicate that electroplating activities took place at this site until June 1981, when the facility ceased operations. The start date for activities at the site is unknown. Activities involved the use of heavy metals. In 1977, a wastewater treatment plant was installed at the facility to treat effluent before it was discharged into the local river. Solids generated at the plant were temporarily stored in an onsite tank and periodically transferred to the disposal cell. The disposal tank was unlined. Analysis of soil samples in the area revealed that soil contamination had occurred via surface runoff. Cadmium and cyanide were the primary contaminants found. The selected remedial action for this operable unit includes: excavation of the contaminated soil within and around the disposal cell and either onsite or offsite treatment using stabilization, with offsite disposal of the treated soil at a permitted Resource Conservation and Recovery Act disposal facility; and backfilling and grading of the excavated area with clean soil to support a vegetative cover. The estimated total present worth cost for this remediation is $140,000-$170,000. (Lantz-PTT)
W91-00556

HYDROGEOLOGIC INVESTIGATIONS SAMPLING PLAN.
For primary bibliographic entry see Field 7A.
W91-00557

SUPERFUND RECORD OF DECISION, JOHN DEERE DUBUQUE WORKS, IA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-188718. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/ROD/RO7-88/021, September 29, 1988. 48p, 5 fig, 3 tab.

Descriptors: *Cleanup operations, *John Deere Dubuque Work Site, *Site remediation, *Superfund, Acids, Aquifers, Bases, Fuel, Groundwater pollution, Groundwater quality, Iowa, Landfills, Solvents, Waste disposal, Wastewater treatment.

The John Deere Dubuque Works (JDDW) site is located approximately 2.5 miles north of the City of Dubuque, Iowa. Prior to 1968, wastes were placed in the low areas of the landfill and combustible materials were burned. Wastes included caustics (sodium or potassium hydroxide), acids (hydrochloric and sulfuric), petroleum distillates (solvents, grinding oils), heavy metals (chromium, lead, zinc), cyanide and paint sludges. Another area of concern at the facility is the site of a 1980, 200,000-gallon diesel fuel spill. The primary contaminants of concern affecting the groundwater are volatile organic compounds including benzene, tetrachloroethylene, trichloroethane, and toluene. The selected remedial action for this site includes: development of an alternative potable water supply for the plant; extraction and offsite discharge of water from the contaminated alluvial aquifer using the existing production wells to maintain drawdown around the plant and landfill areas; continuation of extraction and treatment of non-aqueous phase liquids (NAPLs) from production well number 3 with offsite discharge of treated groundwater and offsite disposal of collected NAPLs; imposition of deed restrictions to prevent inappropriate use of the plant property in the future; and development of a contingency plan to insure that contaminants do not migrate offsite in the event of a plant shutdown (which would result in the loss of drawdown from production wells). The estimated present worth cost for this remedial action is $5,151,800 with annual operations and maintenance costs of $276,600. (Lantz-PTT)
W91-00559

SYLVAN LAKE RESTORATION PROJECT.
Utility Engineering Corp., Rapid City, SD.
G. Wierenga, and F. Payne.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-209118. Price codes: A07 in paper copy, A01 in microfiche. July 1987. 138p, 44 fig, 11 tab, 13 ref. EPA Grant No. S008293-01.

Descriptors: *Cleanup operations, *Eutrophic lakes, *Lake restoration, *South Dakota, *Sylvan Lake, Algal blooms, Eutrophication, Lakes, Nutrients, Phosphates, Phosphorus, Recreation, Sedimentation, Water quality, Water quality management.

Sylvan Lake is a small man-made lake (7.5 hectares) located in Custer State Park, SD. A focal point of intense recreational activity, the lake has experienced severe aesthetic and water quality problems. Shoreline and watershed areas were denuded of vegetation and active erosion of the unprotected soils resulted in accelerated sedimentation to the lake. The reduction in depth of the lake from sedimentation and nutrient loadings associated with the sedimented particles had resulted in undesirable aesthetics (algal blooms), limited access, and reduced fish habitat. The Sylvan Lake Restoration Project was initiated by the South Dakota Department of Game, Fish, and Parks in 1979 with the general objectives of correcting watershed and in-lake problems, and controlling activities detrimental to the recreational experience provided by the lake and its surroundings. Construction activities included: (1) partial removal of lake sediment deposits; (2) paving existing gravel surface access roads and parking areas; (3) construction of new hard surface access roads and parking areas; (4) surface restoration and revegetation; and (5) construction of sediment control structures. In addition to the construction activities, the project included changes in management practices and land uses by Custer State Park to enhance and accommodate restoration activities. During construction activities, the lake showed an increase in total phosphorous, dissolved orthophosphate, suspended solids and ammonia as nitrogen concentrations. With the exception of orthophosphate, all concentrations were about the same level

before the project began and after the construction activities ceased. (Lantz-PTT)
W91-00562

LAKE RESTORATION PROJECT, NORTH HUDSON PARK LAKE, BERGEN, NEW JERSEY.
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-209043. Price codes: A03 in paper copy, A01 in microfiche. Final Report, January 1985. 14p, 2 ref, append.

Descriptors: *Cleanup operations, *Eutrophic lakes, *Eutrophication, *Lake restoration, *New Jersey, *North Hudson Park Lake, *Water quality, Algae, Algal blooms, Fish populations, Nutrients, Phosphorus, Sedimentation.

North Hudson Park Lake is a small urban water body which exhibited classic signs of cultural eutrophication. Suffering from neglect and intense watershed development, the lake was filling with silt, supported unpleasantly high algal populations, had a declining fisheries and was generally aesthetically unacceptable. A proposed restoration plan was approved in 1981, which included dredging 85,000 cu yd of bottom sediments, shoreline stabilization, repair of storm sewers, revegetation of adjacent park land, and outlet repair and modification. After project completion, analysis of water quality data of the in-lake stations showed measured improvement. Prior to restoration, the mean total phosphorous in lake value was 0.26 mg/L, with a minimum value of 0.04 mg/L, and a maximum of 0.49 mg/L. After-project monitoring values for mean total phosphorous were 0.12 mg/L, with a minimum of 0.03 mg/L and a maximum of 0.22 mg/L. This is an approximate 53% reduction in total phosphorous values in-lake. There was a substantial decline in algal populations by approximately 3,000%, and a substantial decrease in ammonia concentrations. Prior to dredging, the in-lake mean concentration of ammonia was 0.20 mg/L. After dredging, the mean concentration was reduced to 0.065 mg/L. North Hudson Lake has been restored to a much higher quality recreation facility. (Lantz-PTT)
W91-00563

DREDGING OF NORTH PARK LAKE, COUNTY OF ALLEGHENY, PENNSYLVANIA.
Pennsylvania Dept. of Environmental Resources, Harrisburg.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-208714. Price codes: A04 in paper copy, A01 in microfiche. Final Report, September 1988. 67p, 5 fig, 3 append. EPA Grant No. S-003250-01.

Descriptors: *Dredging, *Ecological effects, *Lake restoration, *North Park Lake, *Pennsylvania, *Sedimentation, *Water quality, Cleanup operations, Costs, Lake sediments, Water resources development.

North Park Lake is located approximately 10 miles north of the City of Pittsburgh. The lake was created by the construction of Pine Creek Dam in the early 1930s and had an original surface area of 75 acres. The maximum water depth as constructed was 15 feet; the average depth of the water prior to dredging was 5 feet. Upstream development has increased the sediment load entering North Park Lake. Prior to dredging, the buildup of sediment within the lake had reduced the surface area by approximately 5 acres. This created a loss of habitat for fish and a decrease in lake area available for recreation. The dredging project is designed to reestablish the original surface area and maintain an average water depth of 5 feet, and was divided into the following phases: (1) Silt trap cleaning and repair; (2) purchase of the dredge; (3) construction of sediment containment area; and (4) dredging of the lake. The total amount of material dredged between April 1984 and November 1986, is estimated at 30,500 cu yd at a cost of approximately $69,450.00. The dredging activity performed to date has noticeably increased the surface area of the lake. This has created new fishing and boating areas. The removal of sediment and plant life above the surface of the lake has improved the appearance of the lake. (Lantz-PTT)
W91-00564

RESPONSE OF THE US EPA REGION V STATES TO THE NONPOINT SOURCE REPORTING REQUIREMENTS OF THE 1987 CLEAN WATER ACT AMENDMENTS.
Wisconsin Univ.-Madison. Inst. for Environmental Studies.
N. Houtman.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-188528. Price codes: A05 in paper copy, A01 in microfiche. EPA Report No. 600/9-89/031, January 1989. 28p, 4 tab.

Descriptors: *Clean Water Act, *Legislation, *Nonpoint pollution sources, *Regulations, *Water pollution control, Federal jurisdiction, Groundwater quality, State jurisdiction, Water pollution sources, Water quality management, Wetlands.

The Clean Water Act Amendments of 1987 passed Congress in February, 1987. Section 319 requires the states to submit reports on the assessment and management of nonpoint source pollution within their borders. Six nonpoint pollution source (NPS) assessment efforts are discussed in these reports which use six different strategies for addressing these requirements. These reports discuss water quality degradation as reflected in three kinds of use levels: fishing, swimming, and aquatic life. Section 319 also asks for identification of the extent of NPS impacts to navigable waters. To do that, the reports need to address three types of water bodies: streams, wetlands and lakes. All states address lakes and streams. Nonpoint impacts to groundwater are also discussed in detail, by each state. However, only Minnesota provides details on wetlands. To the extent that wetlands are accurately defined and impacts assessed, these waterbodies can provide valuable clues about NPS effects on physical and biotic systems (e.g., cycling of nutrients, trapping of sediment, or species changes). Their absence from the reports represents a major gap and needs to be addressed in the 1990 reports. Although the reports differ in standards and assessment levels, they all give varying information on each state's NPS pollution. (Lantz-PTT)
W91-00565

ROLE OF STANDARDS IN IOWA'S GROUNDWATER PROTECTION PROGRAM: A REPORT TO THE IOWA GENERAL ASSEMBLY.
Iowa Dept. of Environmental Quality, Des Moines.
J. Combs, D. Koch, R. Kelley, L. Smith, and M. Wnuk.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-219612. Price codes: A04 in paper copy, A01 in microfiche. January 1989. 49p, 2 tab, 2 append.

Descriptors: *Groundwater pollution, *Groundwater protection, *Groundwater quality, *Iowa, *Regulations, *Water pollution control, *Water quality control, Legislation, Water quality management.

An analysis of the role of groundwater standards in Iowa's overall groundwater protection effort is presented. The analysis addresses the historical use of standards for environmental protection, current federal and state programs which use standards, Iowa's current groundwater protection program, and the potential role of standards for groundwater in Iowa. The report makes three specific recommendations on the role of groundwater standards: (1) to continue and enhance the current program of preventing contamination through research; (2) demonstration and education; (3) to adopt cleanup guidelines, based on current EPA lifetime health advisories (for contaminants in drinking water), to direct cleanup of existing areas of contamination, and to require development and implementation of a control strategy for nonpoint source contamination, in the event that voluntary efforts are unsuccessful. (See also W91-00567) (Lantz-PTT)
W91-00566

ROLE OF STANDARDS IN IOWA'S GROUNDWATER PROTECTION PROGRAM: A REPORT TO THE IOWA GENERAL ASSEMBLY, APPENDIX 2 - WRITTEN COMMENTS.
Iowa Dept. of Environmental Quality, Des Moines.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-219620. Price codes: A05 in paper copy, A01 in microfiche. January 1989. 338p.

Descriptors: *Groundwater protection, *Groundwater quality, *Iowa, *Regulations, *Water pollution control, *Water quality control, Groundwater pollution, Legislation, Water quality management.

This report, an appendix to the Report to the Iowa General and Assembly, contains copies of all written comments and letters received by the Department of Natural Resources during the public comment period on groundwater standards. Multiple copies of the same letter received were reproduced only once. (See also W91-00566) (Lantz-PTT)
W91-00567

PESTICIDES AND WETLANDS OVERSEAS: A FRAMEWORK FOR MITIGATING ADVERSE IMPACTS.
California Univ., Berkeley. Graduate School of Public Policy.
G. Goldenman.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-189732. Price codes: A05 in paper copy, A01 in microfiche. EPA Report No. 600/9-89/014, 1988. 76p, 5 fig, 127 ref, 4 append.

Descriptors: *Developing countries, *Pesticides, *Water pollution control, *Wetlands, Africa, Agriculture, Ecological effects, Environmental protection, Literature review, Water pollution prevention, West Germany.

Pesticides can enter wetlands through direct spraying, as in vector control, or indirectly, through agricultural runoff, industrial contamination, or airborne deposition. A valuable function of wetlands is their ability to act as a sink for hazardous chemicals. Conversely, chemicals can overload a wetland's ability to break down pollutants, therefore adversely effecting the biota of the wetland ecosystem. In looking at how pesticides affect fragile ecosystems like wetlands, it is important to assess both acute and long-term impacts. Wetland destruction and pesticide misuse are examples of environmental problems that have been exacerbated by economic development at the expense of the environment. A study examined pesticide affected wetlands globally, and reviewed the scientific literature to determine some preliminary steps toward devising effective policies for safeguarding wetlands in developing countries. Three case studies were examined which include: African tsetse fly control with respect to African Trypanosomiasis; examination of a 20 year old orchard drainage ditch in West Germany and species diversity; and rice cultivation in Southeast Asia with regard to the effects of pesticide use. (Lantz-PTT)
W91-00570

MEASUREMENT OF IN SITU RATES OF SELENATE REMOVAL BY DISSIMILATORY BACTERIAL REDUCTION IN SEDIMENTS.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W91-00620

CREATING CONDITIONS FOR CHANGES IN PREY COMMUNITY STRUCTURE BY CHAOBORUS SPP. IN A LAKE IN SWEDEN.
Goeteborg Univ. (Sweden). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00697

EVALUATING THE PROBABILITY OF VIOLATING DISSOLVED OXYGEN STANDARD.
Wyoming Water Research Center, Laramie.
Y.-K. Tung.
Ecological Modelling ECMODT, Vol. 51, No. 3/4, p 193-204, June 1990. 1 fig, 3 tab, 18 ref.

Descriptors: *Dissolved oxygen, *Mathematical models, *Standards, *Water pollution control, *Water quality control, *Water quality standards, Comparison studies, Estimating equations, Mathematical equations, Probabilistic process, Streeter-Phelps equation.

One of the main concerns in water quality control and regulation is the assurance of compliance of the specified water quality standard. Due to the existence of various uncertainties in a stochastic stream environment, such compliance cannot be guaranteed at all times. Methodologies are discussed for evaluating the risk of violating a specified water quality standard using the Streeter-Phelps equation. A numerical example was prepared using the Streeter-Phelps dissolved oxygen (DO) model. Because of the existence of various uncertainties in stream environments, the impact of water quality decisions should be assessed using probabilistic methodologies. These techniques can be applied to other water quality indicators along with appropriate mathematical models. Comparisons of two first-order methods, mean-value first-order second moment (MFOSM) and advanced first-order second-moment (AFOSM), were made in terms of their accuracy for computing the risk of violating the DO standard. It was found that, when the risk level is high, the two methods yield rather compatible results, but as the risk level decreases the AFOSM method is superior to the MFOSM method. In places where water quality management decisions are made carefully, the risk of having negative events happen usually is small. To estimate such risk accurately, it is recommended that the more sophisticated AFOSM be used. The use of the MFOSM method based on the Streeter-Phelps equation overestimates the risk of violating the water quality standard. This might lead to over-conservative water management decisions. (Rochester-PTT)
W91-00715

HYDROGEN SULFIDE TREATMENT SYSTEMS IN SANITARY SEWERS.
HDR Engineering, Inc., Denver, CO.
For primary bibliographic entry see Field 5D.
W91-00769

COMMERCIAL OXYGEN USE IN WATER-QUALITY MANAGEMENT.
Vanderbilt Univ., Nashville, TN.
For primary bibliographic entry see Field 5D.
W91-00770

STATE AGRICULTURAL POLLUTION REGULATION: A QUANTITATIVE ANALYSIS.
Harvard School of Public Health, Boston, MA. Dept. of Health Policy and Management.
A. Rosenthal.
Water Environment & Technology WAETEJ, Vol. 2, No. 8, p 51-57, August 1990. 2 fig, 3 tab.

Descriptors: *Agricultural runoff, *Agricultural watersheds, *Farm wastes, *Nonpoint pollution sources, *Water pollution control, *Water pollution sources, Conservation, Erosion control, Florida, North Carolina, Pennsylvania, Regression analysis, Regulations, Statistical analysis, Water law.

Water pollution in the U. S. may be attributed principally to agricultural nonpoint sources (NPS). The objectives of NPS policies are generally the same. There are several best management practices (BMPs) that reduce runoff and the concentration of nutrients, pesticides, and sediment. These practices include traditional erosion-control measures such as terraces, waterways, and conservation tillage; and other water quality practices such as animal-waste storage and application, fertilizer management, and integrated pest management (IPM). The effectiveness of agricultural NPS programs in North Carolina, Florida, and Pennsylvania was assessed through a telephone survey of over 700 farmers. The survey was designed on the basis of several interviews and in consultation with the U. S. Department of Agriculture's (USDA) National Agricultural Statistical Service. Chi-square tests and a variety of logistic-regression analyses suggest that Florida's NPS intervention has succeeded in changing farmer behavior with respect to BMP implementation. Upward trends in BMP use before intervention were noted for all three states. It may be argued that without the cost-share program in North Carolina, county enforcement in Pennsylvania, and the powerful effect of regulations in Florida, BMP implementation would have leveled off, or not improve as much as it did. The study also confirmed the ability of a permitting system to dramatically change the practices of a farming population. (Korn-PTT)
W91-00801

ENVIRONMENTAL RUSSIAN ROULETTE: COMPLIANCE AT OR NEAR THE DETECTION LEVEL.
Nixon, Hargrave, Devans and Doyle, Rochester, NY.
L. Ford, R. Henrichs, and D. Spadacene.
Water Environment & Technology WAETEJ, Vol. 2, No. 8, p 58-63, August 1990. 5 tab.

Descriptors: *Analytical methods, *Detection limits, *Environmental policy, *Measuring instruments, *Pollutant identification, Compliance, Environmental protection, Judicial decisions, Legal aspects, Regulations.

Although analytical capabilities continue to improve, compliance has not kept pace with the public's goal to restore sites to virtually pristine levels. In attempting to track mandated cleanup standards or permit limits, analytical capabilities are being pushed to, and beyond, their limits. Measurement of contaminants at the minute levels of some standards is subject to substantial uncertainty. While the U. S. Environmental Protection Agency (EPA) has formally recognized this uncertainty in other contexts, the agency has yet to be consistent in its process of setting, monitoring, and enforcing cleanup requirements or permit limits. Because of the minute detection limits of some contaminants, new measurement methods have been developed that detect contaminants at lower concentrations. Unfortunately, quantification at these minute levels is not exact. EPA has recognized the uncertainty of some analytical methods and has incorporated an acceptable amount of error in its regulations (as much as 40%) when concentrations are below 10 micro g/L. The issue of reliability of analytical results is often raised when results are challenged by a measurement device or a sophisticated measurement method. However, before a court will admit such evidence or rule that it is sufficient to support a conviction, the court requires some some evidence confirming the reliability of the measurement device or method and the competence or qualifications of the individual doing the analysis. A hypothetical case study is presented that demonstrates the advisability of including the potentially responsible party (the discharges) in the design of the monitoring program and setting of realistic compliance levels. (Korn-PTT)
W91-00802

DECHLORINATION OF FOUR COMMERCIAL POLYCHLORINATED BIPHENYL MIXTURES (AROCLORS) BY ANAEROBIC MICROORGANISMS FROM SEDIMENTS.
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5B.
W91-00827

TOXICITY OF 1,1,1-TRICHLOROETHANE AND TRICHLOROETHENE ON A MIXED CULTURE OF METHANE-OXIDIZING BACTERIA.
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
K. Broholm, B. K. Jensen, T. H. Christensen, and L. Olsen.
Applied and Environmental Microbiology AEMIDF, Vol. 56, No. 8, p 2488-2493, August 1990. 6 fig, 1 tab, 27 ref.

Descriptors: *Water pollution treatment, *Soil treatment, *Cleanup, *Chlorinated hydrocarbons, *Toxicity, *Bacteria, Methane bacteria, Degradation, Trichloroethene, Trichloroethane, Model studies, Inhibition, *Site remediation, Soil contamination, Groundwater pollution.

Aerobic biodegradation of chlorinated aliphatics by methane-oxidizing bacteria is a possible way to remediate contaminated soil and groundwaters. However, the applicability of this technique may be hampered by the toxicity of high concentrations of chlorinated aliphatics to the methanotrophic bacteria. The influence of trichloroethene (TCE: 0 to 65 mg/L) and 1,1,1-trichloroethane (1,1,1-TCA: 0 to 103 mg/L) on methane consumption of a mixed culture of methane-oxidizing bacteria was studied in laboratory batch experiments. Increasing concentrations of TCE or 1,1,1-TCA resulted in decreasing methane consumption. Methane consumption was totally inhibited at a concentration of 13 mg/L TCE, while methane consumption was still observed at the upper studied concentration of 103 mg/L 1,1,1-TCA. The inhibition of methane consumption by TCE depended on the initial concentration of methane. A model accounting for competitive inhibition between methane and TCE or 1,1,1-TCA was used to simulate methane consumption at various concentrations of TCE or 1,1,1-TCA. The simulations indicated that competitive inhibition may be the mechanism causing the inhibitory effect of TCE on methane consumption, while this does not seem to be the case for 1,1,1-TCA. (Author's abstract).
W91-00832

TETRACHLOROETHENE TRANSFORMATION TO TRICHLOROETHENE AND CIS-1,2-DICHLOROETHENE BY SULFATE-REDUCING ENRICHMENT CULTURES.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W91-00833

CLOSURE OF AN UNLINED EVAPORATION POND: A CASE HISTORY.
Army Engineer District, Fort Worth, TX.
M. G. Green, and A. J. Marr.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 27, No. 2, p 235-243, May 1990. 7 fig, 4 tab, 9 ref.

Descriptors: *Cleanup, *Evaporation ponds, *Hazardous wastes, *Munitions wastes, *Sludge disposal, *Waste disposal, *Water pollution control, Case studies, Groundwater pollution, Permits, Resource Conservation and Recovery Act, Sludge, Soil contamination, Texas, Underground waste disposal, Wastewater disposal.

In 1985, the Fort Worth District, Corps of Engineers, successfully permitted and executed the closure of an unlined evaporation pond at the Longhorn Army Ammunition Plant in east Texas. The pond, constructed in 1963 at the site of an active explosive waste-burning ground area, had been used to store explosive wastes resulting from the washout of rock motor casings and solvent residues from operations involving pyrotechnic material preparation and mixing. Because operation of the unlined evaporation pond appeared to be primarily responsible for locally contaminating the groundwater, the Army ceased operation of the pond in 1984 and began formal closure activities for the unit as a Resource Conservation and Recovery Act (RCRA) interim status surface impoundment. Under Phase I of the closure contract, a total of 1,877,113 gal of wastewater was removed and shipped via tank truck to a permitted disposal well some 80 mi from the site. The Phase II contract consisted of removing and transporting contaminated sludges and soils to a permitted hazardous waste disposal site, backfilling the pond, installing a filter drain system, and turfing. A total of 8,116 cubic yd of material was excavated and

shipped from the site. An increasing number of closures of hazardous waste facilities are anticipated in the future. A detailed project summary of the case history on each project should be documented and published so that planners of similar projects may benefit. (Author's abstract)
W91-00855

MATHEMATICAL MODELLING OF SEA WATER INTRUSION, NAURU ISLAND.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
For primary bibliographic entry see Field 2L.
W91-00865

EFFECTS OF CATCHMENT LIMING AND AFFORESTATION ON THE CONCENTRATION AND FRACTIONAL COMPOSITION OF ALUMINUM IN THE LOCH FLEET CATCHMENT, SW SCOTLAND.
Stirling Univ. (Scotland). Dept. of Environmental Science.
I. C. Grieve.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 385-396, July 1990. 3 fig, 2 tab, 27 ref.

Descriptors: *Acid rain, *Acid rain effects, *Acidic water, *Aluminum, *Forest watersheds, *Liming, *Scotland, *Water pollution treatment, *Watershed management, Acid streams, Chemical analysis, Dissolved organic carbon, Forest hydrology, Iron, Neutralization, Sulfates.

The most rapid method of neutralizing excess acidity due to acid deposition is the application of neutralizing materials such as limestone powder or fragments either directly to streams and lakes, or indirectly to the surface of catchment soils. Concentrations of total, total monomeric and organic monomeric forms of aluminum and of iron, anions and dissolved organic carbon (DOC) in streams draining one forested and two moorland catchments in southwest Scotland were measured over a 3-year period. Catchments were limed during the study and comparisons of stream chemistry were made before and after liming under the two land-use types. Within individual events, DOC and anion concentrations increased with increasing discharge, and aluminum concentrations showed little change with discharge. In the pre-liming phase as a whole, organic monomeric Al was strongly correlated with DOC and inorganic monomeric Al was strongly correlated with anions, particularly Cl. The forested catchment had higher mean DOC and SO4, but lower mean Al. After liming, Al concentrations were reduced, by up to 80% for monomeric forms, and these low levels prevented observation of correlations with DOC and anions. Liming treatments were effective in both forested and moorland catchments, lasted for at least 2.5 years after treatment, and low rates of application to bog areas were as effective as entire catchment treatments. (Author's abstract)
W91-00897

HAZARDOUS-WASTE TREATMENT COMES OF AGE.
Hazardous Waste Treatment Council, Washington, DC.
R. C. Fortuna.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 1.3-1.7.

Descriptors: *Environmental protection, *Hazardous waste disposal, *Legal aspects, *Resource Conservation and Recovery Act, *Superfund, *Waste disposal, *Wastewater treatment, Cleanup operations, Environmental policy, Land disposal, Legislation.

The enactment of the Superfund Amendments and Reauthorization Act (SARA) in 1986 and the Hazardous and Solid Waste Amendments (HSWA), which amend the Resource Conservation and Recovery Act (RCRA), in 1984, represents both the culmination of the 10-year flirtation with failure and a commitment to prevent the propagation of future problem sites and uncontrolled management practices. The process of implementing the Superfund and RCRA laws throughout the early eighties reinforced many of the fundamental lessons that were emerging for those responsible for congressional oversight. In the area of hazardous-waste cleanup it was learned that simply attempting to cap, pump, and treat or dispose wastes was more of a shell game than a solution. As a result very specific restrictions on land disposal and surface impoundments were imposed and many regulatory loopholes were closed. However, the most enduring and fundamental reform issuing from this legislation was a restructuring of the regulatory decision-making process itself. The legislation: (1) establishes a national policy which states that land disposal is to be the method of last resort in the management of hazardous wastes; (2) institutes presumptive prohibitions against the land disposal of all hazardous wastes; and (3) supports the presumptions with a statutory set of minimum controls and self-implementing total prohibition in the event that the EPA does not act to override or modify them by a specified date. The new demand and the changes it brings with it pose their own set of challenges, primarily in the permitting of RCRA facilities and timely expansion of capacity. It is necessary to ensure that new capacity is permitted on a timely bases, and that there is sufficient flexibility to modify facilities in order to meet the demands of the new laws. (See also W91-00900) (White-Reimer-PTT)
W91-00901

SUMMARY OF CERCLA LEGISLATION AND REGULATIONS AND THE EPA SUPERFUND PROGRAM.
Weston (Roy F.), Inc., Washington, DC.
For primary bibliographic entry see Field 6E.
W91-00903

UNDERGROUND STORAGE TANKS.
Clean Site, Inc., Alexandria, VA.
D. C. Ammon, and S. R. Cochran.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 1.47-1.59, 3 fig, 1 ref.

Descriptors: *Cleanup operations, *Hazardous materials, *Storage tanks, *Underground storage, *Water pollution sources, Design criteria, Emergency planning, Environmental protection, Legislation, Monitoring, Public health, Regulations.

An estimated 3 to 5 million underground tanks in the United States are used to store liquid petroleum and chemical substances. Concern for the status of underground storage tanks has resulted in the development of legislation regarding the registration and monitoring of existing tanks, design and installation of new tanks, and corrective actions for releases. Leaks can occur from storage tanks and associated piping and pumping via leaks from corrosion; from system rupture due to overloading, external stresses, or puncture; and from faulty construction or installation. Overfilling is another source of a tank-system release. The four classes of methods for detecting leaks in underground storage tanks are: (1) volumetric leak testing and leak-rate measurement; (2) nonvolumetric leak testing, (3) inventory controls; and (4) monitoring of environmental effects. Corrective-action responses for leaking underground storage tanks can be divided into two categories. Initial responses are directed at controlling the immediate impacts resulting from newly discovered or sudden releases. If an emergency situation exists, immediate responses may include notification of fire departments, evacuation, removal of ignition sources, and venting of flammable vapors. Permanent corrective measured are directed at cleanup of the releases to some acceptable level for protection of human health and the environment. (See also W91-00900) (White-Reimer-PTT)
W91-00904

QUANTITIES AND SOURCES OF HAZARDOUS WASTES.
Westat Research, Inc., Rockville, MD.
For primary bibliographic entry see Field 5E.
W91-00905

HAZARDOUS-WASTE MANAGEMENT CAPACITY.
MITRE Corp., McLean, VA.
For primary bibliographic entry see Field 5E.
W91-00906

SITING OF HAZARDOUS-WASTE FACILITIES.
North Carolina Univ. at Chapel Hill. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5E.
W91-00907

TREATMENT AND CONTAINMENT TECHNOLOGIES.
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
S. C. James, and P. J. Rogoshewski.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 12.35-12.50, 2 fig, 1 tab, 24 ref.

Descriptors: *Hazardous waste disposal, *Waste containment, *Waste disposal, *Waste treatment, *Water pollution control, *Water pollution prevention, Groundwater pollution, Groundwater pumping, Low-permeability barriers, Sludge treatment, Subsurface drains.

Containment technologies are used to contain waste or contaminated groundwater or to keep uncontaminated water from entering the waste. This is accomplished by three commonly used methods: (1) groundwater pumping, (2) subsurface drains, and (3) low-permeability barriers. One alternative to waste excavation and removal and conventional pump-and-treat methods is to treat wastes in situ. In situ treatment entails the use of chemical or biological agents or physical manipulations which degrade, remove, or immobilize contaminants; methods for delivering solutions to the subsurface; and methods for controlling the spread of contaminants and treatment reagents beyond the treatment zone. In situ treatment processes are generally divided into three categories: biological, chemical, and physical. Other techniques include aqueous-waste treatment, solids treatment, solidification and stabilization, and thermal processes. Potential solutions for site remediation will almost always include a variety of technologies. Containment technologies and treatment technologies will invariably be used together. In addition, various technologies will be used to solve problems associated with the treatment of liquids, solids, and sludges at the same site. However, in addition to containment and treatment technologies, other aspects such as materials handling, worker safety, protection from accidental releases, and protection from future financial liability must be incorporated into the complete plan for site remediation. (See also W91-00900) (White-Reimer-PTT)
W91-00956

SITE REMEDIATION.
Science Applications International Corp., McLean, VA.
R. S. Wetzel.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 12.51-12.61, 4 fig, 3 tab, 6 ref.

Descriptors: *Cleanup, *Hazardous waste disposal, *Site remediation, *Waste disposal, Closure, Monitoring, Regulations, Water pollution control.

Site remediation incorporates the use of specific technologies such as capping, slurry trenching, and groundwater treatment to address specific problems identified in the site-investigation process. The currently accepted practices and U.S. EPA guidelines include remedial investigation (RI), feasibility study (FS), corrective action, and closure. The ultimate goal of the RI and FS is to develop data to support the selection of an approach for site remediation and then to use this data in a structured procedure that results in a well-supported recommended approach. The remedial investi-

gation must establish site characteristics such as media contaminated, the extent of contamination, and the physical boundaries of the contamination. The purpose of the feasibility study is to document the problem(s) identified in the RI, determine the range of possible solutions, and select the best solution to waste-site problems. Criticisms of past RI/FS projects by the EPA have been that they take too much calendar time to complete, supporting data is insufficient or minimally adequate, key alternatives are not evaluated, and evaluation and rational for the alternatives presented are insufficient. The corrective-action program under the Resource Conservation and Recovery Act (RCRA) goes into effect when the RCRA groundwater-monitoring program (for the uppermost aquifer) identifies contaminants significantly above permitted levels. Waste-site closure consists of final design of the remedial action, implementation, and postclosure monitoring and maintenance. Postclosure monitoring and maintenance must be conducted as long as the site is considered a threat. (See also W91-00900) (White-Reimer-PTT)
W91-00957

CONTROL AND DISPOSAL INDICES FOR COMPARING WASTE-MANAGEMENT ALTERNATIVES.
PEER Consultants, Inc., Rockville, MD.
For primary bibliographic entry see Field 5E.
W91-00959

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

PRESENT AND FUTURE PERSPECTIVES OF WATER RESOURCES IN DEVELOPED COUNTRIES.
Politecnico di Milano (Italy). Inst. of Hydraulics.
U. Maione.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 2, p 101-115, 1988. 3 fig, 5 tab, 36 ref.

Descriptors: *Comprehensive planning, *Future planning, *History, *Hydrology, *Planning, *Systems analysis, Consumptive use, Flood control, Water cycle, Water quality, Water resources management.

Based upon some present and past features of water resources in developed countries, some future trends are outlined towards the development of water sciences. The reduction of specific consumption use, the amelioration of water quality, increasing water resources, and the improvement of flood control measures should dictate innovation of water resources technology. Decision analysis will hopefully play a larger role in water resources analysis and planning than it does at present. Systems analysis for water resources applications has suffered due to insufficient reliability of basic data, inadequacy of models, and the marked insensibility of many models to variation of design parameters. Interdisciplinary cooperation is critical to future progress in hydrology. These trends will also introduce new perspectives in the development of hydrological sciences, thus indicating a route to overcome the present crisis. (Tappert-PTT)
W91-00067

PRINCIPLES OF A GROUND-WATER STRATEGY.
Greeley-Polhemus Group, Inc., West Chester, PA.
W. Whipple, and D. J. Van Abs.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 503-516, July/August 1990. 2 tab, 3 ref.

Descriptors: *Groundwater management, *Legal aspects, *State jurisdiction, *Water law, *Water policy, *Water quality management, *Water resources management, Alternative planning, Legislation, New Jersey, Nonpoint pollution sources, Water supply.

A groundwater strategy is a policy document that outlines how a state can best manage its groundwater, consistent with budgetary limitations and with provisions of federal and state law. Such a strategy has been adopted in New Jersey which establishes policies for water supply and water quality protection. The strategy includes two new directions critically important to successful groundwater management. First, a state program was proposed to control nonpoint sources of groundwater pollution. Second, the strategy corrected the lack of coordination among state programs that provide alternative water supplies to replace contaminated wells and among programs requiring cleanup of hazardous water pollution. Alternative water supplies that are constructed without regard to pollution mitigation may allow the party responsible for the pollution to escape liability for full remedial costs. Due to such circumstances, water supply remedies in severe cases may be delayed, even where sufficient public funds exist. The strategy solved this problem through a common priority system for both water supply and pollution mitigation remedies, and by addressing first those portions of cases that pose major public health risks and afterward, the remaining portions of these cases. (Author's abstract)
W91-00183

COMBINED SEWER OVERFLOW: A MANAGEMENT STUDY.
Environmental Protection Agency, Washington, DC. Office of Marine and Estuarine Protection.
For primary bibliographic entry see Field 5D.
W91-00568

FUZZY REGRESSION IN HYDROLOGY.
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft.
For primary bibliographic entry see Field 7C.
W91-00596

ENVIRONMENTAL RISK-ASSESSMENT AND AUDIT PRINCIPLES.
Environmental Strategies Corp., Vienna, VA.
For primary bibliographic entry see Field 5E.
W91-00909

HYDROLOGY AND MANAGEMENT OF DROUGHT IN THE UNITED STATES.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00991

GENERALIZED COMPONENTS OF COMPLEX DECISION SUPPORT SYSTEMS FOR WATER RESOURCES MANAGEMENT IN RIVER BASINS.
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 4A.
W91-00997

OBJECT-ORIENTED HYDROLOGICAL MODELLING (MODELISATION HYDROLOGIQUE ORIENTEE OBJECT).
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Genie Rural.
For primary bibliographic entry see Field 2A.
W91-00999

6B. Evaluation Process

ENDPOINTS FOR REGIONAL ECOLOGICAL RISK ASSESSMENTS.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 6G.
W91-00025

HYDROLOGY PAST AND PRESENT.
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
For primary bibliographic entry see Field 2A.
W91-00066

PRESENT AND FUTURE PERSPECTIVES OF WATER RESOURCES IN DEVELOPED COUNTRIES.
Politecnico di Milano (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 6A.
W91-00067

DECISION-MAKING PROCESS ON THE DANUBE AND THE PLATTE.
Nebraska Dept. of Water Resources, Lincoln.
A. Bleed, H. P. Nachtnebel, I. Bogardi, and R. J. Supalla.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 479-487, June 1990. 2 fig, 17 ref. NSF Grant No. INT 8620200 and Austrian Research Council Grant No. P6502B.

Descriptors: *Danube River, *Decision making, *Platte River, *Political aspects, *Public policy, *River basin development, Conflict resolution, Institutional constraints, Policy making, Public participation, Regional planning, Water allocation.

Two case studies highlighting the institutional arrangements and decision-making processes used to attempt to allocate water on large scale river systems in two countries are presented. In both cases the implementation of river plans has been blocked by conflicts between those who wish to use water for irrigation, hydropower, or municipal purposes and those who wish to maintain instream flows for fish and wildlife. To date conflict has blocked the implementation of a large hydropower scheme on the Danube River, downstream from Vienna, Austria, and the construction of municipal and agricultural projects, as well as the relicensing of an existing hydropower facility on the Platte River in Nebraska. Analysis of the decision-making processes and institutional settings of both cases led to the identification of problem areas and development of recommendations that would support the achievement of compromise solutions for management. In order to arrive at sound conflict resolution, the decision-making system needs to be improved by (1) using project evaluation that is able to handle a full range of alternatives with conflicting objectives, and (2) establishing an institutional setting that promotes a transparent and rational negotiation process. Both the Platte and Danube experiences suggest that the major institutional requirements for effective decision making include: (1) extensive and well-defined procedures for securing and responding to public input throughout the planning and development process; (2) a lead organization that has the authority to address the full range of options, to engage all affected parties in negotiation, and to implement the politically chosen solution; and (3) a political coalition that is powerful enough to secure the resources and implement the negotiated solution. (Peters-PTT)
W91-00088

DYNAMICS OF SIMULATED EFFECTS OF IRRIGATION OVER DRYLAND FARMING IN SASKATCHEWAN.
Saskatchewan Univ., Saskatoon. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 3F.
W91-00091

SIMULATION OF LAND USE CHANGES AND IMPACTS ON THE WATER BALANCE: A CASE STUDY FOR BELGIUM.
Institut Royal Meteorologique de Belgique, Brussels.
For primary bibliographic entry see Field 4C.
W91-00162

TRENDS IN IRRIGATION DEVELOPMENT, AND THEIR IMPLICATIONS FOR HYDROLOGISTS AND WATER RESOURCES ENGINEERS.
For primary bibliographic entry see Field 3F.
W91-00377

TOWARD EMPIRICAL ESTIMATION OF THE TOTAL VALUE OF PROTECTING RIVERS.
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
L. D. Sanders, R. G. Walsh, and J. B. Loomis.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1345-1357, July 1990. 3 fig, 7 tab, 57 ref.

Descriptors: *Management planning, *Recreation demand, *Statistical analysis, *Water resources management, *Water use, *Watershed management, Colorado, Cost-benefit analysis, Environmental protection, Instream water use, Public opinion, Resource allocation, River protection, Rocky Mountains, Social values.

A study was conducted to develop and apply a procedure to estimate a statistical demand function for the protection of rivers in the Rocky Mountains of Colorado. Other states and nations around the world face a similar problem of estimating how much they can afford to pay for the protection of rivers. The demand for rivers was measured using the contingent valuation method recommended by federal guidelines (U.S. Water Resources Council, 1979; 1983) on a sample of 241 households. Nearly all of the households surveyed favored protection of rivers. Annual benefits of the three most valuable rivers in Colorado (Cache la Poudre, Elk, and Colorado at Westwater Canyon) were estimated as $40 per household, including about $8 onsite recreation use value and $32 offsite preservation value. Consideration of the offsite values of rivers in addition to the onsite recreation values is recommended in determining the total value of rivers to society. (MacKeen-PTT)
W91-00584

BENEFITS OF AN IRRIGATION WATER RENTAL MARKET IN A SALINE STREAM-AQUIFER SYSTEM.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 3F.
W91-00586

WATER BANKING THROUGH ARTIFICIAL RECHARGE, LAS VEGAS VALLEY, CLARK COUNTY, NEVADA.
Las Vegas Valley Water District, NV.
For primary bibliographic entry see Field 4B.
W91-00880

CASE STUDY OF A SUCCESSFUL FACILITY SITING.
For primary bibliographic entry see Field 5E.
W91-00910

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER AUCTIONS AS AN ALLOCATION MECHANISM IN VICTORIA, AUSTRALIA.
Department of the Interior, Washington, DC. Office of Program Analysis.
B. Simon, and D. Anderson.
Water Resources Bulletin WARBAQ, Vol. 26, No. 3, p 387-395, June 1990. 1 fig, 6 tab, 14 ref.

Descriptors: *Australia, *Licensing, *Water allocation, *Water auctions, *Water costs, *Water resources management, *Water rights, Auctions, Highest value use, Irrigation water.

During recent years many countries have moved to rationalize the management of state owned or state controlled resources. Victoria, Australia, has taken the unusual step of using auctions to allocate new irrigation water entitlements. The six water auctions that took place during 1988 and early 1989 were perceived as an efficient and equitable mechanism to allocate limited water supplies to their highest value use. While the agricultural areas where the different auctions occurred were similar, there was substantial variation in the prices paid, which reflects varying demands for additional irrigation water. The auctions demonstrated that the water had an annual value to license holders of at least $Aus 15/megaliter above existing charges. However, by excluding irrigation district members and urban areas, competition was constrained and the chances of selling greater volumes to higher value uses were reduced. Allowing irrigators in irrigation districts to participate would have greatly increased the number of potential bidders. Limiting the amount of water any individual could purchase and the staging procedure also introduced an degree of inefficiency into the auction process. While the auctions represent a major change in Victoria's water allocation procedures, they only provide a portion of the flexibility that modern water management systems require. By making water entitlements transferable, individuals who were not able to acquire water in an auction could purchase or lease it from those who were able to acquire it. (Peters-PTT)
W91-00080

EFFECT OF SYSTEM LAYOUT ON SUBSURFACE DRAINAGE COST IN FLAT IRRIGATED LAND.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Center for Drainage Studies.
For primary bibliographic entry see Field 4B.
W91-00081

MEASURING ECONOMIC LOSSES FROM GROUND WATER CONTAMINATION: AN INVESTIGATION OF HOUSEHOLD AVOIDANCE COSTS.
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 5C.
W91-00086

BRIDGES AND CULVERTS REDUCED IN SIZE AND COST BY USE OF CRITICAL FLOW TRANSITIONS.
Shire of Stawell (Australia).
For primary bibliographic entry see Field 8B.
W91-00100

COST SAVINGS THROUGH CHEMICAL ADDITION SEQUENCING.
Texas Univ. at El Paso. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-00102

COST IMPACTS OF SEDIMENTS IN SOUTH AFRICAN RIVERS.
Hydrological Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 2J.
W91-00295

COST EFFECTIVENESS OF THE STREAMFLOW-GAGING PROGRAM IN WEST VIRGINIA.
Geological Survey, Charleston, WV.
For primary bibliographic entry see Field 2E.
W91-00331

COST AND PERFORMANCE OF MEMBRANES FOR ORGANIC CONTROL IN SMALL SYSTEMS: FLAGLER BEACH AND PUNTA GORDA, FLORIDA.
University of Central Florida, Orlando. Dept. of Civil Engineering and Environmental Sciences.
For primary bibliographic entry see Field 5F.
W91-00448

COMPETITIVE ASSESSMENT OF THE U.S. WATER RESOURCES INDUSTRY.
International Trade Administration, Washington, DC.
For primary bibliographic entry see Field 6D.
W91-00561

SIMULATING PHYSICAL PROCESSES AND ECONOMIC BEHAVIOR IN SALINE, IRRIGATED AGRICULTURE: MODEL DEVELOPMENT.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 3C.
W91-00585

COST PERSPECTIVES FOR HAZARDOUS-WASTE MANAGEMENT.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5E.
W91-00960

6D. Water Demand

WATER SUPPLY FOR MEXICO CITY.
Universidad Autonoma Metropolitana, Mexico City. Unidad Iztapalapa.
For primary bibliographic entry see Field 3D.
W91-00020

WATER SUPPLY IN FAST-GROWING CITIES: TOKYO, JAPAN.
Bureau of Waterworks, Tokyo (Japan). Water Supply Operation Centre.
Y. Sekine.
Aqua AQUAAA, Vol. 39, No. 2, p 86-95, April 1990. 7 fig, 8 tab.

Descriptors: *Human population, *Japan, *Metropolitan water management, *Tokyo, *Water demand, *Water resources development, *Water supply, Economic aspects, Urbanization, Water pollution, Water quality management, Water rates, Water supply management.

Tokyo, the center of politics and economy in Japan, has produced large numbers of water consumers, reaching almost 12 million. Consequently, the following problems have occurred: (a) shortage of water resources; (b) pollution of raw water; (c) ceaseless expansion of facilities; (d) financial problems. Recently, in accordance with the steady growth in the economy, the water demand has levelled off. The capacity of production is sufficient for the current water demand. It is now time to renovate the facilities and, therefore, reconstruction work becomes more important. As one of the lifelines supporting urban activities, the waterworks should respond to various metropolitan needs, such as reliability and stability. Future financial, administrative, and research plans of the waterworks are presented. (Author's abstract)
W91-00021

WATER FLOWS TOWARD MONEY: THE COMPLICATED STORY OF RENO, NEVADA'S WATER SUPPLY PROBLEMS.
C. Ross.
Water Well Journal WWJOA9, Vol. 44, No. 4, p 55-59, April 1990. 1 fig.

Descriptors: *Groundwater, *Nevada, *Water demand, *Water law, *Water resources development, *Water use, Economic aspects, Groundwater basins, Political aspects, Water quality, Water supply.

The Reno/Sparks/Carson City urban area on the western edge of the Great Basin desert in Nevada has always suffered from water problems. In many areas, precipitation is less than 8 inches per year. According to the major water provider, customers have increased by 30% in the last 10 years and other sources cite a 4% annual growth rate for the area. Yet Reno remains one of the last western cities not using water meters. Users are charged a flat rate based on the diameter of their hookup. Not only is the source of water to fuel this growth in serious doubt, but there are problems with the bacterial and metal content of the water. Unfortunately, these water systems were built to sell houses, not to provide lasting quality, cost-effective water. The use of Nevada's tiny, uncertain desert rivers and lakes by an incredibly complex set of upstream and downstream agricultural, recreational, environmental, domestic, and industrial interests has created problems not only for maintaining its increasing human population but also in preserving its parks and wildlife population. Al-

though the use of groundwater, which is legally apportioned in Nevada, has helped alleviate the situation, the reality exists of a finite water supply against an uncontrolled growth, creating additional problems. This is especially true in western Nevada, where groundwater basins are shared with neighboring California. There have been a series of protests and legislative actions by both states regarding appropriation and allocation of groundwater. (Medina-PTT)
W91-00054

EFFECT OF DROUGHT ON URBAN WATER SUPPLIES. I: DROUGHT ANALYSIS.
Resource Consultants, Inc., Fort Collins, CO.
D. M. Frick, D. Bode, and J. D. Salas.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 733-753, June 1990. 6 fig, 8 tab, 39 ref.

Descriptors: *Climatology, *Drought, *Drought effects, *Model studies, *Stochastic models, *Trees, *Water deficit, *Water shortage, *Weather patterns, Planning, Water resources management, Water supply.

Communities in arid areas, where total annual surface-water withdrawals approximate and in some years exceed average overall water availability, are faced with difficult and urgent problems concerning water policy and management approaches. The City of Fort Collins, Colorado has conducted studies to determine the effects of prolonged droughts on the city's water supplies. As a result of the analysis, various water-supply strategies were developed to be used by the city for handling the problems associated with extreme droughts. The study utilized stochastic modeling coupled with water-resource-system modeling to evaluate drought effects on the water supplies of the city. A stochastic model was developed for the five river basins that account for the city's water supplies. The stochastic model was verified with 400 years of tree-ring data obtained for the area. Periods of records were then generated to determine potential droughts that could occur. Representative 1-in-20, 1-in-50, 1-in-100, and 1-in-500 year droughts were selected for analysis. These droughts are designated 'design' droughts for use in the water supply analysis. The analysis indicated that historically experienced droughts such as those of the 1930s and 1940s do not represent as severe a drought as previously thought. (See also W91-00060) (Tappert-PTT)
W91-00059

EFFECT OF DROUGHT ON URBAN WATER SUPPLIES. II: WATER-SUPPLY ANALYSIS.
Resource Consultants, Inc., Fort Collins, CO.
D. M. Frick, D. Bode, and J.D. Salas.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 754-764, June 1990. 3 fig, 2 tab, 5 ref.

Descriptors: *Climatology, *Drought, *Drought effects, *MODSIM model, *Metropolitan water management, *Model studies, *Planning, *Stochastic models, *Water deficit, *Water requirements, *Water shortage, Water resources management, Water rights, Water supply.

Using a water resource system model, the water supply system of the City of Fort Collins, Colorado, which consists of five river basins, was simulated for selected drought periods to determine the yield of the city's existing water supplies and for other potential water supply sources. The Cache le Poudre River basin is the major water supply for the city. Several approaches were used to estimate the yields of various water supply sources imported from adjacent basins during a 500-year period. A water-rights model (MODSIM) was used to simulate allocations of water supplies based on existing and future water-rights ownership scenarios for the city. The program was run to simulate conditions basin-wide and also to simulate conditions for the city water supply only. Safe demand levels were determined to assure adequate water availability during extreme drought events. Five different scenarios were simulated, ranging from the existing supply system to projected conditions in 2035. The results of the study indicated that although water supplies for the city are adequate at the present time, policies should be adopted to assure that supplies are adequate to meet future demands during drought periods. The study provided a tool to use in evaluating the drought sensitivity of new water sources for meeting future water demands. The approach presented has widespread application to evaluation of droughts on western urban water supplies. (See also W91-00059) (Author's abstract)
W91-00060

ESTIMATED RUNOFF FROM MAN-MADE SNOW.
Wright Water Engineers, Inc., Denver, CO.
For primary bibliographic entry see Field 2C.
W91-00092

OPTIMAL PLANNING AND OPERATION OF MULTIAQUIFER SYSTEM.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Earth Sciences.
For primary bibliographic entry see Field 4B.
W91-00179

OPPORTUNITIES FOR RESERVOIR-STORAGE REALLOCATION.
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 6E.
W91-00186

SOURCES OF WATER-USE INFORMATION IN MAINE.
Maine Geological Survey, Augusta. Dept. of Conservation.
D. H. Tepper, and E. M. Lanctot.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report No. 84-4. 38p, 8 ref.

Descriptors: *Data collections, *Databases, *Information systems, *Maine, *Water use, Environmental impact, Groundwater, Resource allocation, Surface water, Water quality.

The nation's water supplies are undergoing stress as a result of increasing demands for water from agricultural, industrial, domestic, and other uses accompanied by demands for greater protection of water quality. Although some detailed information is available on the quantity and quality of surface water and groundwater, data are lacking on the amount of water used, where it is used, and how it is used. Water use information is necessary for definition and efficient resolution of many critical water-related problems involving water quality, environmental impact, energy development, and resource allocations. In order to address the growing national concern about adequacy of water supplies, the U S Geological Survey (USGS) began a cooperative state/federal water-use information program in 1977. As an outgrowth of the national program, the Maine Geological Survey, in cooperation with the USGS, has initiated the development of a comprehensive water-use data program, the Maine Water-Use Data System (MWUDS). A summary of data appropriate for central filing, and anticipated future water-use information needs are included in this source booklet. The sections are arranged by water-use categories. Each category is defined and the appropriate standard industrial classification codes for the category are listed. Descriptions of data elements which will be stored in the national system and optional data to be included in the Maine system are presented. A tentative approach for MWUDS data collection is summarized, sources of information are listed, and where appropriate, a bibliography is given at the end of each section. (Shidler-PTT)
W91-00443

COMPETITIVE ASSESSMENT OF THE U.S. WATER RESOURCES INDUSTRY.
International Trade Administration, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-200687. Price codes: A07 in paper copy, A01 in microfiche. October 1985. 118p, 10 fig, 31 tab, 30 ref, 2 append.

Descriptors: *Economic aspects, *Management planning, *Water resources development, Desalination, Irrigation, Legislation, Marketing, Regulations, Wastewater treatment, Water resources management, Water supply, Water treatment.

A study of the water resources industry was completed in June 1985, and examines developments as they relate to demand and markets in the six subsectors of the water resources industry: water desalination and reuse; water and wastewater treatment; irrigation; groundwater exploration and development; point of use water treatment; and water supply and distribution. In 1983, there were approximately 1500 water resource equipment manufactures in the US employing 516,000 workers. In 1983, the US industry shipments were $22 billion. The US market is served primarily by US firms but import penetration is increasing. Twenty percent of US shipments in 1983 were exported to more than 75 countries. However, US exports peaked in 1981 and have been declining since then. This decline is attributed to the high value of the dollar, the global recession, and intensified foreign competition. This study identifies a number of areas in which the US government might consider supporting water resource firms' competitiveness, including: improved competitive financing, greater coordination in export promotion, increased research and development support, elimination of certain tariff and non-tariff barriers, and support of specific legislation which would enhance the water resource markets. (Lantz-PTT)
W91-00561

TOWARD EMPIRICAL ESTIMATION OF THE TOTAL VALUE OF PROTECTING RIVERS.
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W91-00584

SLIPS AHOY.
Johnson, Johnson and Roy, Inc., Ann Arbor, MI.
For primary bibliographic entry see Field 8A.
W91-00677

6E. Water Law and Institutions

IMPROVING THE EFFECTIVENESS OF FISHERIES AGENCIES IN DEVELOPING HYDROPOWER MITIGATION.
Oak Ridge National Lab., TN. Environmental Sciences Div.
S. F. Railsback, C. C. Coutant, and M. J. Sale.
Fisheries (Bethesda) FISHDN, Vol. 15, No. 3, p 3-8, 1990. 1 fig, 7 ref. DOE Contract DE-AC05-84OR21400.

Descriptors: *Environmental protection, *Fisheries, *Hydroelectric power, *Regulations, *Water resources development, Information exchange, Institutions, Legislation, Licensing, Mitigation.

New legislation and Federal Energy Regulatory Commission (FERC) regulations increase the responsibilities of state and federal fisheries management agencies for developing mitigation for hydropower projects. Having participated in some of the first major licensing cases since these changes, observations are presented on how agencies can be more effective in recommending mitigation measures that protect fisheries. Fisheries agencies need access to expertise in fields outside traditional fisheries management to address diverse hydropower impacts. Agencies need effective policies that can be applied to the specific conditions at each project. Coordination and communication between regulatory and resource agencies and with project applicants are important to establish agreement on mitigation recommendations and to share expertise. Agencies will often need to make recommendations on issues for which complete information is not available; if carefully designed, such recommendations can be defensible and conservative. A

thorough understanding of current FERC procedures and policies is essential. Many of these same recommendations for effective mitigation are included in the Fish and Wildlife Service's hydropower mitigation policy. (Author's abstract)
W91-00008

WATER FLOWS TOWARD MONEY: THE COMPLICATED STORY OF RENO, NEVADA'S WATER SUPPLY PROBLEMS.
For primary bibliographic entry see Field 6D.
W91-00054

DECISION-MAKING PROCESS ON THE DANUBE AND THE PLATTE.
Nebraska Dept. of Water Resources, Lincoln.
For primary bibliographic entry see Field 6B.
W91-00088

OPPORTUNITIES FOR RESERVOIR-STORAGE REALLOCATION.
Hydrologic Engineering Center, Davis, CA.
W. K. Johnson, R. A. Wurbs, and J. E. Beegle.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 550-566, July/August 1990. 9 fig, 3 tab, 7 ref.

Descriptors: *Governmental interrelations, *Kansas, *Operating policies, *Reservoir operation, *Reservoir storage, *Resource allocation, *Water allocation, *Water resources management, Dams, Economic aspects, Feasibility studies, Flood control, Hydrologic aspects, Legal aspects, Political aspects, Regulations, State jurisdiction, Water conservation, Water storage, Water supply.

When a reservoir is constructed, water storage volumes are authorized for different purposes, and operating policies are established to control water releases. A review of studies on reallocation of reservoir storage capacity for reservoirs in the U.S. Army Corps of Engineers and state of Texas has identified eight general cases of reallocation: (1) use of water supply storage not under contract; (2) temporary use of storage allocated for future conservation purposes and sediment; (3) storage made available by change in conservation demand or purpose; (4) seasonal use of flood-control space during dry seasons; (5) reallocation of flood-control space; (6) modification of reservoir-water-control plan and method of regulation; (7) raising existing dams; and (8) system regulation of Corps and non-Corps reservoirs. While these general cases suggest a variety of opportunities for reallocation, feasibility must be evaluated for each specific site. A memorandum of understanding between the state of Kansas and the Department of the Army illustrates the different hydrologic, economic, environmental, legal, and institutional considerations required in reallocation investigations and the value and necessity of cooperation between responsible parties. (Author's abstract)
W91-00186

PROFESSIONAL CERTIFICATION AND REGISTRATION FOR WATER-RESOURCES AND RELATED DISCIPLINES.
American Water Resources Association, Bethesda, Maryland. 1989. 69 p. Edited by A. Ivan Johnson.

Descriptors: *Professional certification, *Professional personnel, *Standards, Institutions, Licensing, Professional societies, Workshops.

Certification and registration of professional specialists in water resources and related disciplines has been a question on the minds of many people this past decade or two. Hearing the frequent questions and the frequently uninformed speculations that followed, the editor decided to organize several seminar-type sessions where knowledgeable specialists could discuss the procresses for professional certification and registration. The papers contained in this publication describe certification programs for the Association of Ground Water Scientists and engineers, American Institute of Hydrology, American Institute of Professional Geologists, American Society for Agronomy, American Society for Photogrammetry and Remote Sensing, National Association of Environmental Professionals, and The Society of American Foresters. In addition there are papers: (1) describing the philosophy of the Association of Engineering Geologists, (2)discussing experiences with registration of geologists and geophysicists in California, (3) explaining the efforts in Arizona to develop professional registration of hydrologists, and (4) discussing new thoughts on certification of engineering specialties. Some of the reasons for certification or registration are described in several papers in this publication. A basic similarity in requirements of certification programs will be seen: a list of basic qualifications of education, experiences and publications; a written or oral examination, which frequently is dropped for people of special eminence in the field; agreement to a specified code of ethics, a system for acting on complaints of unethical practice; and a need for maintaining competence and renewing certification. (See W91-00268 thru W91-00279)
W91-00267

CASE FOR STATE CERTIFICATION OF WATER EXPERTS.
National Water Well Association, Dublin, OH.
J. H. Lehr.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 3-6.

Descriptors: *Professional personnel, *Standards, *State jurisdiction, Association of Ground Water Scientists a, Education, Licensing, Regulations, Training.

All states should consider the development of a certification exam in concert with the professional societies which govern these disciplines in the same manner as certified public accountants assist the states in their certification program. Reliance on voluntary certification programs developed by professional societies such as the Association of Ground Water Scientists and Engineers (AGWSE), a division of the National Water Well Association, appears to be the best approach. They introduced their own certification program in 1985 in response to a significant demand from their membership. Successful applicants who become Certified Ground Water Professionals earn the right to use CGWP after their name. To earn CGWP, an applicant must have at least seven years of progressively more responsible professional experience, following receipt of a baccalaureate degree, during which competence has been demonstrated in the application of scientific or engineering principles and methods to the execution of work involving: (1) the understanding of the occurrence, movement and composition of groundwater, or (2) the development, management or regulation of groundwater, (3) the teaching and research of groundwater subjects at the university level. Education may be substituted for this experience. Explicit descriptions of the qualifying work experience must be presented. A two (2) three-person certification committee decides for or against an applicant. Individuals denied certification may petition for a personal hearing before a review committee that denied his or her original application. To date, over 3000 persons have submitted applications for certification, with nearly 150 becoming certified. (See also W90-00267) (Lantz-PTT)
W91-00268

AMERICAN INSTITUTE OF HYDROLOGY.
Environmental Strategies Corp., Vienna, VA.
J. E. Moore.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 7-10, 1 fig.

Descriptors: *American Institute of Hydrology, *Professional personnel, *Standards, Education, Licensing, Professional societies, Training.

The American Institute of Hydrology (AIH) was formed in 1981 to provide a certification procedure for professionals in all fields of hydrology. The objective of the AIH certification is to strengthen the standing of hydrology as a science and a profession by: establishing standards to certify qualified hydrologists; establishing and maintaining ethical standards to protect the public from irresponsible work; and providing education and training in hydrology. The Institute adheres to the principle of responsible professional conduct and public service. In 1989 the Institute had 756 members, 16 associate members, and 14 corporate members. AIH has established chapters in 40 states and 4 countries. AIH is an organization whose principle aim is to enhance and strengthen the science of hydrology. It achieves this objective by certifying hydrologists, holding technical meetings, assisting state and federal agencies, and cooperating with hydrologic professional organizations. (See also W90-00267) (Lantz-PTT)
W91-00269

PROFESSIONAL REGISTRATION FOR GEOLOGISTS AND ENGINEERING GEOLOGISTS.
Santa Clara Valley Water District, San Jose, CA.
R. E. Tepel.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 11-18, 1 fig, 1 tab, 6 ref.

Descriptors: *Engineering, *Geology, *Professional personnel, *Standards, Education, History, Licensing, Training.

As sciences and professions, engineering and geology share a history of development in which each interacted with the other for many centuries. Water resources development has been a prime factor in the growth of each field. Early civil engineers were forced to invent the geology they needed to build their canals, tunnels and aqueducts. By the late 19th century it was not uncommon for civil engineers in charge of major water supply projects to retain a geologist (usually a college professor) as a consultant. In terms of sheer numbers, the professional registration of geologists and engineering geologists got its biggest boost with the passage of the California Registration Act in 1968. The Association of Engineering Geologists was instrumental in passing the California Act, and continues to support state-by-state registration of geologists, with recognition of the specialty of engineering geology. Engineering geologists almost always, but other geologic specialties on occasion, practice an applied science that directly impacts the public health, welfare, and safety. Professional registration imposes a responsibility on engineering geologists commensurate with the importance of their contribution to the safe design and construction of engineering works. (See also W91-00267) (Lantz-PTT)
W91-00270

AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS: COMPETENCE, INTEGRITY, ETHICS.
American Inst. of Professional Geologists, Arvada, CO.
W. V. Knight.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 19-21.

Descriptors: *American Institute of Professional Geol, *Professional personnel, *Standards, Geology, Licensing, Professional societies, Public relations.

Geology is both a science and a profession. In taking the title of geologist, members identify themselves as part of an established scientific discipline. The American Institute of Professional Geologists (AIPG) is founded on the premise that the strengthening of geology as a profession likewise strengthens geology as a science. The AIPG, a voluntary individual membership association, was organized in 1963 to deal with the professional concerns of all geologists. Since its inception, the Institute has grown to a membership of 4500 certified professional geologists. AIPG membership in-

cludes representatives from all geological disciplines, including engineering geology, geohydrology, minerals and petroleum. All activities of the Institute are directed and funded by geologists themselves. AIPG is the sole organization whose major purpose is to strengthen geology as a profession. The professional practice of geology involves economics, business practices, governmental functions, policy decisions, and competition. Therefore, much of AIPG's work involves interaction between member geologists and the public domain. The seal of AIPG carries the terms: competence, integrity, and ethics. It is these words which guide AIPG's major activities in certification, representation, information and education. (See also W90-00267) (Lantz-PTT)
W91-00271

CERTIFICATION IN THE AMERICAN METEOROLOGICAL SOCIETY.
National Oceanic and Atmospheric Administration, Rockville, MD. Federal Coordinator for Meteorological Services and Supporting Research.
R. L. Carnahan.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 23-25.

Descriptors: *American Meteorological Society, *Professional personnel, *Standards, Licensing, Meteorology, Professional societies, Training.

The Certified Consulting Meteorologist Program of the American Meteorological Society is more than 30 years old. Approximately 425 meteorologists have been certified and the program is growing at the rate of 15-25 certificates being granted each year. There are currently 60 candidates under consideration for certification. The American Meteorological Society will soon be 70 years old. Its objective is the development and dissemination of knowledge of the atmospheric and related oceanic and hydrologic sciences and the advancement of their professional applications. Today it has approximately 10,000 members. This figure represents 80% of the professional meteorologists in the nation. While the Society concentrates heavily on the sciences, which are its principle focuses, it also attempts to address professional applications in a number of ways. In addition to the Society's program for Certified Consulting Meteorologists, it also operates a program to award seals of approval to radio and television weathercasters. The qualifications for certification are: knowledge, experience, and character. Lack of a college degree is not a bar to certification. Qualification on the basis of experience requires a minimum of five years of work at the professional level. To provide a basis for qualification on the basis of character, the application requires the naming of at least three professional references. The certification program is administered by the Board of Certified Consulting Meteorologists consisting of five certified members who contribute their time and interest to the program. Unsuccessful candidates are allowed to reapply for certification two years from the date of denial of their application. Applicants not approved by the board may appeal within 90 days from the receipt of notice to the Executive Committee of the Society. (See also W90-00267) (Lantz-PTT)
W91-00272

AGRONOMISTS: EVALUATION OF PROFESSIONAL COMPETENCE.
American Society of Agronomy, Madison, WI.
J. M. MacCubbin.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 27-36, 2 fig, 3 tab, 2 ref.

Descriptors: *Professional personnel, *Standards, Agronomy, American Society of Agronomy, Education, Licensing, Professional societies.

Society has long demanded professional competence of members of various professions; it was in the 1960's that members of the American Society of Agronomy and the Soil Society of America requested a means for recognizing professional competence. This certification program ARCPACS (American Registry of Certified Professionals in Agronomy, Crops and Soils) was established by the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America in 1977 to evaluate the educational experience and ethical credentials of individuals whose activities are with public and private agencies. In the initial stages of development of the program, it was the intent of the Society to provide a service which would recognize professionals at education levels other than PhD. The certification program has met its primary intent. About 2/3 of the Registry are professionals with baccalaureate or masters degrees. The certification program was initiated at a time when professionals of other disciplines were also requesting a means of professional recognition in their respective areas of expertise. The ARCPACS program has become more viable and recognized since the enactment of various state and federal rules, which require some standard of competence of individuals in the agronomic sciences. As ARCPACS certification continues to be recognized in courts of law and by government regulatory agencies and employers, the program should experience continued growth. The future should include added programs and services, particularly for consultants and practicing professionals with baccalaureate and masters degrees. (See also W90-00267) (Lantz-PTT)
W91-00273

AMERICAN SOCIETY FOR PHOTOGRAMMETRY AND REMOTE SENSING VOLUNTARY CERTIFICATION PROGRAM.
Coyote (E.) Enterprises, Inc., Eugene, OR.
R. Chamard.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 37-39, 1 tab.

Descriptors: *American Society for Photogrammetry and, *Professional personnel, *Standards, Aerial photography, Licensing, Photogrammetry, Professional societies, Remote sensing.

A program was developed for certifying photogrammetrists which was approved by the Board of Directors of the American Society for Photogrammetry on March 13, 1975. The program is entirely voluntary. The Board felt that certification was one way for an individual to be recognized by colleagues and peers as having truly demonstrated professional integrity and competence in one or more subdivisions of photogrammetry. It also felt that the program would encourage members to improve their skills and promote professional practice. Photogrammetry and remote sensing are the art and science of obtaining reliable information about physical objects and the environment through the process of recording, measuring and interpreting imagery and digital representations of energy patterns derived from noncontact sensor systems. Conventional photogrammetry includes the compilation of topographic and other maps from information obtained from aerial photographs. (See also W90-00267) (Lantz-PTT)
W91-00274

NATIONAL ASSOCIATION OF ENVIRONMENTAL PROFESSIONALS--CERTIFICATION PROGRAM.
National Association of Environmental Professionals, Alexandria, VA.
C. F. Zirzow, and R. F. Ehrhardt.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 41-43.

Descriptors: *National Association of Environmental P, *Professional personnel, *Standards, Education, Licensing, Professional societies, Training.

The Certification Program of the National Association of Environmental Professionals (NAEP) is designed to recognize those members of the environmental community who are specially qualified by a combination of education, experience and proven accomplishment. Certification requires submittal of educational transcripts, summaries of work experience, and written answers to essay questions focused on an applicant's particular field or discipline. NAEP's Certification Review Board reviews the documentation and contacts professional references with a knowledge of the applicant's qualifications. Following a favorable finding by the Review Board and action by the Board of Directors of the Association, the applicant is accorded the status of 'C.E.P.', Certified Environmental Professional. (See also W91-00267) (Lantz-PTT)
W91-00275

CREDENTIALING IN THE FORESTRY PROFESSION.
P. G. Smith.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 45-46.

Descriptors: *Forestry, *Licensing, *Professional personnel, *Standards, *State jurisdiction, Alabama, Arkansas, California, Georgia, Legislation, Maine, Maryland, Michigan, Mississippi, North Carolina, Oklahoma, South Carolina, Training, West Virginia.

Results from a 1988 survey of 50 states show that only 12 have active registration or licensing programs for foresters. They include: Alabama, Arkansas, California, Georgia, Maine, Maryland, Michigan, Mississippi, North Carolina, Oklahoma, South Carolina, and West Virginia. Of these 12, only California and Maine require mandatory licensing in order to practice forestry. The others comprise voluntary registration programs. This finding represents no change in numbers of registration and licensing programs since the last survey results in 1983. Five additional states are now actively pursuing enacting forester registration legislation. Others are expected to follow suit. Credentialing is governed by a hierarchy beginning with accreditation, and moves through certification, registration and licensing. Certification is similar to accreditation in that it is a voluntary process but it differs in registration in that a nongovernmental organization attests to the professional qualifications of the individual. Registration is similar to certification, it requires an individual to meet specified standards of education and/or professional experience. Qualifying exams must also be passed. Licensing is a compulsory procedure by which a state grants qualified individuals the right to practice their occupation. Currently, California and Maine license foresters. (See also W91-00267) (Lantz-PTT)
W91-00276

HISTORY OF REGISTRATION OF GEOLOGISTS AND GEOPHYSICISTS IN CALIFORNIA.
Law Environmental, Inc., Burbank, CA.
G. A. Browm.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 47-49.

Descriptors: *California, *Professional personnel, *Standards, Civil Engineers Registration Act, Geology, Geophysics, History, Legislation.

The first registration attempts for geologists and physicists were made through the efforts of the California Association of Engineering geologists. There are two types of registration: (1) protection of the practice act which signifies that those professionals working in a given field of practice cannot sell their services to the public without being registered; and (2) protection of the title act which reserves the use of the title 'geologist' or 'geophysicist' to those qualified.The history began with the enactment of the Civil Engineers Registration Act in 1930 which was ammended in 1947 to include professional engineers in the chemical, electrical, petroleum, and mechanical fields. The

first registration bill for geologists was introduced in 1963, and a grandfathering process was started in 1969 for preventing those qualified through experience from being legislated out of business. The profession of geology in California has been spurred on by disasters. The mandates of the Clean Water Act have also added new dimensions to the need for qualified professionals. (See also W91-00267) (Lantz-PTT)
W91-00277

PROFESSIONAL REGISTRATION FOR HYDROLOGISTS IN ARIZONA: A PROPOSAL PREPARED BY THE ARIZONA HYDROLOGICAL SOCIETY.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
E. S. Simpson, and D. Young.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 51-56.

Descriptors: *Arizona, *Licensing, *Professional personnel, *Standards, *State jurisdiction, Regulations.

In recent years Federal and State laws have been enacted designed to conserve the quantity and protect the quality of public water supplies, and to reduce the adverse impacts of flooding and public expenditures for flood control works and post-disaster assistance. These laws and the public's awareness of the need to conserve and protect water supplies has resulted in an explosive market for professionals trained in the hydrological sciences. In Arizona the need for well trained hydrologists is acute. The population influx continues to promote new housing developments, many of which require the development of new water sources resulting in an increase in competition for water supplies. A summary of the need for the professional registration of hydrologists in Arizona emphasizes that: (1) the practice of hydrology is distinct and different from either civil engineering or geology; (2) the explosion in demand for hydrologists requires state registration for quality assurance; (3) hydrologic conditions and water law in Arizona are unique. State registration will ensure that hydrologists practicing in Arizona will be qualified to deal with problems particular to the state; (4) registered engineers should be relieved of the need to sign reports prepared by hydrologists when the report requires a state seal; (5) hydrologists must be held responsible for the quality of their work; and (6) the exclusion of professional hydrologists from protection offered registered professionals for the recovery of fees through mechanic's lien rights (House Bill 2229), is not fair to hydrologists and can be corrected by offering state registration to hydrologists. (See also W91-00267) (Lantz-PTT)
W91-00278

ENGINEERING SPECIALTY CERTIFICATION.
National Inst. for Certification in Engineering Technologies, Alexandria, VA.
J. D. Antrim.
IN: Professional Certification and Registration for Water-Resources and Related Disciplines. American Water Resources Association, Bethesda, Maryland. 1989. p 57-60.

Descriptors: *Engineering, *Professional personnel, *Standards, Licensing, Regulations.

Although broad engineering disciplines such as civil, electrical, and mechanical engineering are still important, the complexities of present-day technology has led to the creation of engineering specialties. The expertise needed to practice competently in a specialty area has brought many practioners to believe that special credentialing is needed to verify that the claimed expertise is real. A national effort to bring order and consistency to engineering specialty credentialing is underway and a proposed entity to provide the needed coordination could be operational early in 1990. This entity must accommodate certification efforts which address different populations such as licensed professional engineers, graduate engineers, engineering technologists, engineering technicians, and professionals whose area of practice falls in what is typically referred to as engineering-related, and that the entity must operate in a manner which spreads control among the populations. Engineering specialty certification will succeed only if there are no 'turf battles' and all of the programs are quality programs meeting uniform minimum standards. (See also W91-00267) (Lantz-PTT)
W91-00279

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1987 - NOVEMBER 30, 1988.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W91-00344

ANNUAL YIELD AND SELECTED HYDROLOGIC DATA FOR THE ARKANSAS RIVER BASIN COMPACT ARKANSAS--OKLAHOMA 1989 WATER YEAR.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-00360

REGULATORY EFFECTS ON THE PRACTICE OF DRINKING WATER TREATMENT.
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5F.
W91-00483

RESPONSE OF THE US EPA REGION V STATES TO THE NONPOINT SOURCE REPORTING REQUIREMENTS OF THE 1987 CLEAN WATER ACT AMENDMENTS.
Wisconsin Univ.-Madison. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5G.
W91-00565

OPERATION AND MAINTENANCE ACTIVITIES OF AN IRRIGATION SYSTEM IN JAVA (IN JAPANESE).
For primary bibliographic entry see Field 3F.
W91-00767

SUMMARY OF RESOURCE CONSERVATION AND RECOVERY ACT LEGISLATION AND REGULATION.
Tufts Univ., Medford, MA. Center for Environmental Management.
J. R. Reinhardt.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 1.9-1.27, 2 tab, 5 ref.

Descriptors: *Environmental protection, *Hazardous waste disposal, *Legal aspects, *Regulations, *Resource Conservation and Recovery Act, Hazardous wastes, Incineration, Land disposal, Legislation.

An overview of existing legislation and regulation, and a context in which to evaluate current and future regulatory activity is presented. The Resource Conservation and Recovery Act (RCRA) of 1976 is the primary legislation controlling hazardous-waste management. RCRA originated as a law with a comprehensive scope; it instituted 'cradle to grave' control of hazardous waste requiring massive and complex regulation due to the diversity of industrial and commercial operations under its purview. The scope of RCRA is discussed in regard to: (1) the framework of regulations in regard to generator responsibilities and waste identification; transporter responsibilities; and treatment, storage, and disposal facility owner and operator responsibilities; (2) its relation to the Comprehensive Environmental Response Compensation and Liability Act (CERLA); (3) the 1984 administrative, financial, enforcement, solid-waste, and reports amendments; and (4) the amendments dealing with hazardous-waste regulations for permits, underground storage tanks, technology, mining, small-quantity generators, and waste oil. The policy of shunning land disposal in favor of incineration and other methods gives rise to a complex process subject to many influences. ONe factor is the complexity of the permitting process for land disposal facilities, with closure and post-closure costs, that encourages more incineration and other treatment facilities. Depending on how the regulations or promulgated and enforced, hazardous-waste management in the United States could change dramatically over the next ten years. (See also W91-00900) (White-Reimer-PTT)
W91-00902

SUMMARY OF CERCLA LEGISLATION AND REGULATIONS AND THE EPA SUPERFUND PROGRAM.
Weston (Roy F.), Inc., Washington, DC.
R. Stanford, and E. C. Yang.
IN: Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Book Company, New York. 1989. p 1.29-1.45, 3 fig.

Descriptors: *Cleanup, *Comprehensive Environmental Response Co, *Hazardous materials, *Legal aspects, *Regulations, *Superfund, *Waste disposal, Emergency planning, Environmental protection, Public health, Remedies.

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) gives the federal government broad authority to respond to releases or the threats of releases of hazardous substances, and to pollutants or contaminants that may present an imminent and substantial danger to the public health or welfare or to the environment. A 'release' is defined to include not only the spilling or leaking of a substance into the environment, but also the abandonment or discarding of barrels, containers, or other closed receptacles that are considered hazardous. The Act provides for long-term actions that are consistent with permanent remedy, known as remedial-response actions, and shorter-term actions in response to immediate danger, known as removal actions. The key provisions of CERLA provide for emergency response, remedial response, and research, development, and demonstration. The two areas of response for the CERCLA Superfund program are: (1) removal response, which is administered by the Emergency Response Division of the Office of Emergency and Remedial Response (OERR); and (2) remedial response which is administered by the Hazardous Site Control Division of OERR. The Superfund removal program provides response to immediate threats to public health, welfare, and the environment. The remedial-response program addresses the releases of hazardous material, pollutants, or contaminants that require complex, long-term response. The Superfund Innovative Technology Evaluation (SITE) program distinguishes between an alternative technology that is currently available, one that is innovative, and one that is emerging. The SITE demonstration program consists of two parts: (1) searching for and identifying prospective innovative alternative technologies, and (2) evaluating the performance of those technologies through demonstration. (See also W91-00900) (White-Reimer-PTT)
W91-00903

6G. Ecologic Impact Of Water Development

ENDPOINTS FOR REGIONAL ECOLOGICAL RISK ASSESSMENTS.
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. W. Suter III.
Environmental Management EMNGDC, Vol. 14, No. 1, p 9-23, January/February 1990. 4 tab, 44 ref.

Descriptors: *Ecology, *Ecosystems, *Environmental policy, *Population dynamics, *Regional planning, *Risk assessment, Air pollution, Environmental effects, Productivity, Water pollution, Water quality standards.

Ecological risk assessments must have clearly defined endpoints that are socially and biologically relevant, accessible to prediction and measurement, and susceptible to the hazard being assessed. Most ecological assessments do not have such endpoints, in part because the endpoints of toxicity tests or other measurements of effects are used as assessment endpoints. This article distinguishes assessment and measurement endpoints in terms of their roles in risk assessments and explains how the criteria for their selection differ. It then presents critical discussions of possible assessment and measurement endpoints for regional ecological risk assessments. Finally, the article explains how endpoint selection is affected by the goal of the assessment. Generic goals for regional risk assessment include explanation of observed regional effects, evaluation of an action with regional implications, and evaluation of the state of a region. Currently, population level assessment endpoints such as abundance and range are the most generally useful. For ecosystems and regions, data are generally not available and the validity of models has not been demonstrated. Physiological and organismal effects are not relevant. However, landscape descriptors, material export, and other regional-scale measurement endpoints show promise for regional assessments. (Author's abstract)
W91-00025

ROLE OF GROUND WATER IN CONTROLLING ECOLOGY OF AREA: A CASE STUDY OF GHANA BIRD SANCTUARY - DISTRICT BHARATPUR, RAJASTHAN.
M. Mehta.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 179-181, 1 fig, 1 tab.

Descriptors: *Ecosystems, *Ghana Bird Sanctuary, *Groundwater management, *India, *Surface-groundwater relations, *Water level, Aquifers, Case studies, Flow discharge.

The Ghana Bird Sanctuary district, in Bharatpur, Rajasthan, is one of the most famous bird sanctuaries in the world. A number of migratory birds travel to the sanctuary each winter. In 1979, the sanctuary suffered from an acute water shortage which effected the ecology of the area and possibly the migration of the birds. The average annual rainfall is 670 mm. The rainfall is also very erratic with a variability of approximately 40%. This has resulted in acute water shortages in the area lake, and the ecology of the area has suffered. To study the lake level with regard to groundwater level, an observation well was put in the sanctuary. Confirmation of a groundwater/lakewater relationship was made through observation. The lake level is marginally higher than the groundwater level. The average loss of water in the lake from 10/77-5/78 was 120 mm/month with a seepage loss of around 40 mm. Any supply scheme to maintain the lake water level over 1 sq km will require about 0.12 million cu m (4000 cu m/day) in addition to the quantity required to fill the lake. It was estimated that around 0.3 million cu m/day would be required to maintain the lake level in limited areas of the sanctuary. In order to augment water in the lake the deeper aquifers should be developed (90-140 m). The deeper aquifer is under artesian pressure and the piezometric head is about 2 to 3 meters above ground level within the entire sanctuary area. The expected free flow discharge from tube wells tapping this aquifer is about 30 cu m/hour. If the wells are pumped the discharge will be about 150 cu m/hour. Consequently, 3 high capacity wells with free flowing conditions were constructed in the lake bed. This has helped continue the present agricultural environment of the lake. (See also W91-00215) (Lantz-PTT)
W91-00234

GEOMORPHIC DESIGN AND MANAGEMENT OF DISTURBED LANDS.
Denver Univ., CO. Dept. of Geology and Geography.
For primary bibliographic entry see Field 4C.
W91-00296

WATER RESOURCES DATA COLLECTED DURING WATER YEAR 1988 AT SELECTED JAMES RIVER BASIN SITES IN NORTH DAKOTA AND SOUTH DAKOTA.
Geological Survey, Huron, SD. Water Resources Div.
S. K. Sando, K. G. Guttormson, and T. A. Gleich.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 90-101, 1990. 230p, 3 fig, 41 tab, 9 ref.

Descriptors: *Dam effects, *Environmental impact, *North Dakota, *South Dakota, *Water resources data, *Water resources development, Discharge measurement, Garrison Diversion Unit, Hydrologic data, Interbasin transfers, James River Basin.

Operation of the proposed Garrison Diversion Unit will supply water from the Missouri River in North Dakota to the upstream part of the James River basin. The U S Bureau of Reclamation initiated a monitoring program in 1984 to aid in determining whether the potential impacts resulting from Garrison Diversion Unit operation will be compatible with the operational objectives of the three national wildlife refuges located on the James River in North Dakota and South Dakota. The report presents water resources data collected by the U S Geological Survey during water year 1988 in the James River basin as part of the Garrison Diversion Unit monitoring program. Water discharge records for 12 stations, reservoir elevation and contents records for one station, stream gage-height records for three stations, and water-quality records for 23 stations are presented. (Author's abstract)
W91-00342

VEGETATIVE CHANGES IN A WETLAND IN THE VICINITY OF A WELL FIELD, DADE COUNTY, FLORIDA.
Geological Survey, Tallahassee, FL.
R. H. Hofstetter, and R. S. Sonenshein.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4155, 1990. 16p, 9 fig, 37 ref. Prepared in cooperation with the South Florida Water Management District.

Descriptors: *Environmental effects, *Florida, *Vegetation, *Wells, *Wetlands, Aerial photography, Ecosystems, Introduced species, Species diversity, Succession.

Plant communities present in 1978 and 1986 were analyzed at 250 random points on stereoscopic pairs of aerial photographs for four study sites in the vicinity of the Northwest Well Field in Dade County, Florida. Sites NW and NE lie northwest of the well field beyond the cone of depression. Site SW lies in the outer part of the cone, and site SE lies within the cone of depression. Relative frequency values for several plant types including herbs, shrubs-small trees, and trees were analyzed by the Heterogeneity G-Test to determine heterogeneity among sites in 1978 and 1986. In 1978, all four sites were dominated by plant communities having herbs, shrubs, or a mixture thereof. The communities at sites NW and NE were similar, and those at SE and SW were somewhat similar. In 1986, sites NW, NE and SE were dominated by a mixture of shrubs and trees. Only at site SW was the relative frequency of occurrence of herbaceous plants still high. At each site, there was a decrease in herbaceous vegetation and an increase in woody vegetation during this period, with the increase in trees being greatest at site SE. Time between the start of the well-field operation in May 1983 and January 1986 photographs was insufficient to allow determination of any direct effects of the well field on the vegetation. Ground-level observations in 1987 and 1988 indicate a trend toward continued increase in dominance of woody plants and a decrease in herbaceous wetland vegetation. Development of a forest of the exotic pest tree Melaleuca is occurring at all four sites, but especially at site SE. Vegetative changes between 1978 and 1986 are attributed to an invasion of Melaleuca, a shortened hydroperiod, and natural succession within the plant communities. (Author's abstract)
W91-00352

DREDGING OF NORTH PARK LAKE, COUNTY OF ALLEGHENY, PENNSYLVANIA.
Pennsylvania Dept. of Environmental Resources, Harrisburg.
For primary bibliographic entry see Field 5G.
W91-00564

EFFECT OF TOSTON DAM ON UPSTREAM ICE CONDITIONS.
Cold Regions Research and Engineering Lab., Hanover, NH.
G. D. Ashton.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A210-119. Price codes: A03 in paper copy, A01 in microfiche. May 1989. 11p, 3 fig, 1 tab, 4 ref.

Descriptors: *Dam effects, *Environmental effects, *Ice formation, *Missouri River, *River ice, *Toston Dam, *Water resources development, Flooding, Ice pressure, Seasonal variation, Water level.

A study was conducted to evaluate the effect of raising the winter period reservoir level at Toston Dam on the Missouri River to an elevation of 3952.6 feet above sea level. At present, the dam is operated as an overflow dam with crest elevation of 3941.6 ft during winter. A proposal to install hydropower at the dam would require replacement of the existing flashboard system with radial gates and maintenance of a higher water level at the dam during winter periods. Under this proposed plan of operation, there is concern about the possible effects of the Crow Creek pumping plant located about two miles upstream, with possible ice related flooding of the Burlington Northern railroad track, which extends along the east side of the reservoir, with the effects of ice on existing islands in the reservoir, and with ice effects at the dam and proposed hydropower facility. The effect of raising the reservoir level of Toston Dam on the Missouri River on water levels upstream during winter periods is assessed. The analysis used the HEC-2 program with the ice option to estimate water levels under present and future raised dam elevations. Ice thicknesses were estimated using a trial and error procedure based on existing ice jam theory. Results of the analysis were validated using field observations from two winters. (Lantz-PTT)
W91-00574

EFFECT OF REGULATION ON 0+ FISH RECRUITMENT IN THE GREAT OUSE, A LOWLAND RIVER.
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
G. H. Copp.
Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 3, p 251-263, June/July 1990. 3 fig, 4 tab, 41 ref.

Descriptors: *Dam effects, *England, *Fish establishment, *Fish populations, *Ouse River, *Regulations, *River systems, *Stream regulation, *Water management, Correspondence analysis, Electrofishing, Flow rates, Spatial distribution.

The recruitment of 0+ fishes in the River Great Ouse, East Anglia, England was investigated using electrofishing by point abundance sampling, in order to compare the distribution and extent of fish reproduction in the river and its annexes (side channels, backwaters, etc.) with similar but unregulated lowland rivers of Europe. In all, 44 sites were sampled during three weeks in August 1989. Correspondence analysis of the site-by-species matrix (44 x 17) in density (fishes per square meter) revealed a slight but notable longitudinal zonation of fish reproduction, unusual for lowland rivers, with the limnophils Blicca bjoerkna, Scardinus erythrophthalmus and Abramis brama limited to lentic downstream sites and the rheophil Barbus

barbus restricted to a few upstream sites. Thus, compared with unregulated rivers of Europe, the River Great Ouse differs by: (1) the absence of pelagic spawners, e.g. Lota lota, which were historically reported as abundant; (2) the reduced range and abundance of both rheophilic and limnophilic cyprinids, e.g. Barbus barbus, Alburnus alburnus, and Blicca bjoerkna, Scardinus erythrophthalmus, Abramis brama, Tinca tinca; and (3) the predominance of generalists throughout the system, Rutilus rutilus downstream and Phoxinus phoxinus with Gasterosteus aculeatus upstream, probably to the additional detriment of the localized specialists, both limnophilic and rheophilic. (Author's abstract)
W91-00777

ENHANCEMENT OF BENTHIC MACROINVERTEBRATES BY MINIMUM FLOW FROM A HYDROELECTRIC DAM.
Versar, Inc., Columbia, MD.
S. B. Weisberg, A. J. Janicki, J. Gerritsen, and H. T. Wilson.
Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 3, p 265-277, June/July 1990. 8 fig, 1 tab, 33 ref.

Descriptors: *Benthic fauna, *Flow rates, *Hydroelectric plants, *Instream flow demand, *Invertebrates, Minimum flow, Population dynamics, Temporal distribution, Water currents.

The biological consequences of instituting a summer minimum flow from the Conowingo Hydroelectric Dam were investigated by comparing invertebrate abundance in the Susquehana River during 1980, when flow shutdowns were frequent, to that in 1982, when the minimum flow (142 cubic m per sec) was maintained. The minimum flow was only maintained from April 15 to September 15, and additional investigations compared invertebrate abundance before and after the minimum flow was terminated in the fall of 1982 and 1983. There was a large difference in summer invertebrate density in the between-year comparison, with an almost 100-fold increase in the year when the minimum flow was maintained. Most of this difference was exhibited by two taxa, chironomids and net-spinning trichopterans. These results were consistent with findings from the fall of 1982 and 1983, when cessation of the minimum flow in September led to the decline of more than three orders of magnitude in both of these taxa. The rate of decline was faster in the shoal habitat (areas dewatered at low flow, but submerged when the minimum flow is released) suggesting that dewatering was the predominant mechanism of effect. Declines were also evident in the channel habitat (always submerged) which suggests that maintenance of current velocity is also an important beneficial component of the minimum flow. (Author's abstract)
W91-00778

MARGINAL ZOOBENTHOS OF A SOUTHERN BRAZILIAN DAM (ZOOBENTHOS LITORANEOS DE UM ACUDE SUL-BRASILEIRO).
Museu de Ciencias Naturais de Fundacao Zoobotanica do Rio Grande do Sul, Porto Alegre (Brazil).
I. L. Veitenheimer-Mendes, V. L. P. Pitoni, R. M. Lanzer, and M. C. P. DaSilva.
Revista Brasileira de Biologia RBBIAL, Vol. 50, No. 1, p 7-14, February 1990. 6 fig, 1 tab, 15 ref. English summary.

Descriptors: *Benthic fauna, *Dam effects, *Limnology, *River systems, Caddisflies, Midges, Oligochaetes, Seasonal variation, Sediment chemistry, Sediment type, Species composition, Species diversity.

A qualitative, quantitative and seasonal study on the marginal zoobenthos was conducted in a small dam at Morro Santana, Porto Alegre, Rio Grande do Sul, Brazil (30 deg 03 min 45 sec and 30 deg 03 min 50 sec south; 51 deg 08 min 06 sec and 51 deg 08 min 15 sec west). Samples were collected monthly from May 1979 to April 1980, in six marginal stations (942 sq cm/station). Sediment characteristics and physical and chemical data measured during the collections are also provided. The marginal zoobenthos is low in number of organisms (1917), but the species diversity is high (23 taxa). The Chironomidae larvae were dominant in the faunal composition with Pisidium punctiferum, Pisidium forense, and Gundlachia concentrica secondarily dominant. Other important faunal components were oligochaetes and trichopteran larvae. (Author's abstract)
W91-00780

SPOT AND ENVIRONMENTAL STUDIES: AN ADVANCED SYSTEM TO COLLECT UP TO DATE GEOGRAPHIC INFORMATION.
SPOT Image Corp., Toulouse (France).
For primary bibliographic entry see Field 7B.
W91-00793

CONCEPTUAL BASIS FOR ENVIRONMENTAL MONITORING PROGRAMS.
Idaho National Engineering Lab., Idaho Falls.
For primary bibliographic entry see Field 7A.
W91-00794

7. RESOURCES DATA

7A. Network Design

RESEARCH ON AGRICHEMICALS IN WATER RESOURCES.
Geological Survey, Iowa City, IA.
For primary bibliographic entry see Field 5B.
W91-00417

BASIS OF HYDRO-CLIMATIC TIME SERIES IN GREENLAND.
Greenland Technical Organization, Copenhagen (Denmark). Section of Hydro-Technical Investigation.
For primary bibliographic entry see Field 7C.
W91-00469

HYDROGEOLOGIC INVESTIGATIONS SAMPLING PLAN.
Available from the National Technical Information Service, Springfield, VA 22161, as DE-89005720. Price codes: A13 in paper copy, A01 in microfiche. Report No. DOE/OR/21548--020, November 1988. 276p, 62 fig, 25 tab, 72 ref, append. DOE Contract DE-AC05-86OR21548.

Descriptors: *Geohydrology, *Missouri, *Network design, *Path of pollutants, *Project planning, *Sampling, *Weldon Spring Site, Hydraulic properties, Quality control, Risk analysis, Water quality control, Water sampling.

The goal of the sampling plan is to identify and develop specific plans for those investigative actions necessary to: (1) characterize the hydraulic regime; (2) define the extent and impact of contamination; and (3) predict future contaminant migration for the Weldon Spring Site (WSS), Missouri and vicinity. This sampling plan is intended to supplement the Quality Assurance Plan (QAPP). The plan describes objectives, work tasks, quality assurance/quality control (QA/QC) procedures and the level of effort required for site characterization and to support a feasibility study. Data developed through this sampling plan will also be used in the risk assessment evaluation. (Lantz-PTT)
W91-00557

HEURISTIC CLOSED-LOOP CONTROLLER FOR WATER DISTRIBUTION IN COMPLEX IRRIGATION SYSTEMS.
Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung.
For primary bibliographic entry see Field 3F.
W91-00582

REGIONAL WATER QUALITY: EVALUATION OF DATA FOR ASSESSING CONDITIONS AND TRENDS.
Geological Survey, Menlo Park, CA. Water Resources Div.
J. Hren, C. J. Oblinger Childress, J. M. Norris, T. H. Chaney, and D. N. Myers.
Environmental Science and Technology ESTHAG, Vol. 24, No. 8, p 1122-1127, August 1990. 12 ref, 4 fig.

Descriptors: *Colorado, *Data interpretation, *Groundwater data, *Hydrologic data collections, *Network design, *Ohio, *Regional analysis, *Surface water data, *Water quality, *Water quality trends, Aquifers, Data collections, Data requirements, Laboratory methods, Streams, Water analysis, Water sampling.

In 1986, a pilot National Water Quality Assessment Program (NAWQA) was begun by the US Geological Survey (USGS). The goals of the NAWQA program are to describe the status and trends in the water quality of the nation's streams and aquifers, and to provide an understanding of the natural and human causes of the observed conditions and trends. In the pilot study, water sampling programs in Colorado (CO) and Ohio (OH) were examined to determine characteristics of data collection activities of government agencies and universities, and to determine the adequacy of resulting data. In Phase I, USGS compiled an inventory of 48 data collection organizations with 115 programs in CO, and 42 organizations with 88 programs in OH. Most samples were from surface water sources, and only a fraction (34% for CO and 5% for OH) met Phase I screening criteria. In the Phase II screen, the 8 criteria used fall into one of two major categories, field practices or laboratory practices. Most of the data passing both the Phase I and Phase II screening were pH, alkalinity, specific conductance, and dissolved oxygen data--factors that broadly characterize water quality. Few acceptable analyses were for trace constituents. Phase III evaluated the extent to which this ambient water quality data can be used to answer major regional and national questions on current water quality conditions, water quality trends, and the relationship of trends to natural versus anthropogenic factors. Both surface and groundwater data collected during 1977 to 1984 were used in Phase III, and the number of measurements at each data collection site was analyzed, as well as the areal distribution of sites. Problem areas included the limited effort directed toward the determination of potentially toxic constituents, lack of areas where samples had been collected over a long period of time, and the lack of standards in field procedures when sampling. (VerNooy-PTT)
W91-00619

CONCEPTUAL BASIS FOR ENVIRONMENTAL MONITORING PROGRAMS.
Idaho National Engineering Lab., Idaho Falls.
G. B. Wiersma.
Toxicological and Environmental Chemistry TXECBP, Vol. 27, No. 4, p 241-249, 1990. 5 fig, 10 ref.

Descriptors: *Chile, *Environmental monitoring, *Experimental design, *Network design, *Risk assessment, *Wyoming, Atmosphere, Comprehensive planning, Ecosystems, Lichens, Mosses, Path of pollutants, Pollutant identification, Sampling.

For the past several years, the Marine Board of the National Research Council, National Academy of Sciences, has been working on a study of a systems analysis of marine environmental monitoring programs. As a result of that study, a set of general technical criteria for designing and evaluating monitoring programs has been proposed and a set of questions was derived to assist in the evaluation of an existing or proposed monitoring network. These questions are set against a pilot study in southern Chile and/or a Wind River Mountain, Wyoming study and are: have the information needs been clearly stated; does the monitoring design reflect cause and effect; will the data sets support a multi-media risk assessment; have preliminary studies been identified, including what data

are already available and how will they be used; is the monitoring program designed for ecosystem level analysis; can the design support large space and time scales; are the study boundaries clearly defined; and how will the information be disseminated; monitoring programs should be set up to reveal pathways of exposure, the distribution of potential compounds, exits from a system, and identification of the most sensitive and critical ecological receptors. In Chile, atmospheric sampling was completed, as well as sampling of streams, lakes, and soil. Mosses and lichens were sampled for trace elements. This variety of test sites reflect the attempt to design a multi-media monitoring program. Both pilot sites experienced extensive preliminary sampling which was extremely useful in the eventual study design. To accommodate ecosystem level analysis, a site inventory is essential. In Chile, this inventory included an analysis of vegetation types and distribution, overstory sampling, dead and down log measurements, estimates of litter mass, tree ring analysis for growth rate, and mapping of stand features. The sampling site in both sites was carefully established, and personnel were trained to support longterm sampling. The principle established are applicable to the development of all monitoring programs. (Brunone-PTT)
W91-00794

ASSESSMENT OF THE US CONSERVATION SERVICE METHOD FOR ESTIMATING DESIGN FLOODS.
Brawijaya Univ., Malang (Indonesia). Fakultas Teknik.
For primary bibliographic entry see Field 2E.
W91-00989

7B. Data Acquisition

FOURIER AND MOMENT METHODS APPLIED TO TWO-DIMENSIONAL RAINDROP IMAGES.
Alabama Univ. in Huntsville.
For primary bibliographic entry see Field 2B.
W91-00055

MEASUREMENT OF RAINDROP SIZE DISTRIBUTIONS USING A SMALL DOPPLER RADAR.
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 2B.
W91-00056

MODELLING LONG-TERM RAINFALL PATTERNS IN NORTH-EAST ENGLAND.
For primary bibliographic entry see Field 2B.
W91-00099

DIFFERENTIAL REFLECTIVITY RADAR HAIL MEASUREMENT TECHNIQUE: OBSERVATIONS DURING THE DENVER HAILSTORM OF 13 JUNE 1984.
Pennsylvania State Univ., University Park. Communications and Space Sciences Lab.
For primary bibliographic entry see Field 2C.
W91-00140

EFFECT OF IRREGULARITIES IN THE DIAMETER CLASSIFICATION OF RAINDROPS BY THE JOSS-WALDVOGEL DISDROMETER.
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 2B.
W91-00141

RADAR RAINFALL FORECASTING METHOD DESIGNED FOR HYDROLOGICAL PURPOSES.
Ecole Nationale des Ponts et Chaussees, Paris (France).
T. Einfalt, T. Denoeux, and G. Jacquet.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 229-244, May 1990. 14 fig, 2 tab, 37 ref.

Descriptors: *Model studies, *Radar, *Rainfall forecasting, *Rainfall-runoff relationships, *Runoff forecasting, *Storm water management, *Urban hydrology, Computer models, Flood forecasting, France, Hydrologic models, Infrared imagery, Rainfall simulators.

Advanced techniques in sewer management need a reliable rainfall forecasting methodology to satisfy the urban hydrologist. Frequent flooding of a Paris, France, suburb caused a need for a real-time control scheme. Studies directed toward the use of radar rainfall forecasts considered three hierarchical control goals: flood prevention, pollution reduction, and cost minimization. A proposed computerized forecasting method is based on recent advances of pattern recognition and image processing. Its user-defined hydrological features focus on heavy rainfall and on accuracy at a small time-area scale. The reliability of the actual forecast is calculated and issued in real-time. One of the typical problems of the 'structured' (pattern recognition) approach has been solved (splitting and merging of echoes), and the same technique has allowed a basis to be established for future development of a simple growth and decay forecast. By comparison with earlier forecasting methods, the proposed method proves to be slightly superior in hydrological terms. However, the appropriate quality criteria always depend on the application. Further research is being undertaken in this direction. The method has been in operation since May 1988. (Fish-PTT)
W91-00156

EVALUATION OF HYDROGEOCHEMICAL PARAMETERS WITH SPONTANEOUS POTENTIAL LOGS.
National Geophysical Research Inst., Hyderabad (India).
I. Radhakrishna, and T. G. Rao.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 245-257, May 1990. 8 fig, 4 tab, 9 ref.

Descriptors: *Borehole geophysics, *Geochemistry, *Geohydrology, *Groundwater quality, *Logging (Recording), *Spontaneous potential logging, *Water chemistry, *Well logs, Aquifer characteristics, Coastal aquifers, Electric potential, Resistivity, Sedimentary basins, Water quality management.

The estimation of groundwater quality for individual aquifers in a multi-aquifer system is beset with many problems. An attempt has been made to quantify the hydrogeochemical parameters using self potential logs for different aquifers in a major coastal sedimentary basin. This involved establishing a relationship between the resistivity of formation water and the 'equivalent formation water resistivity' for the system and then using analytical scatter diagrams between dissolved solids and various individual cations and anions. The results obtained through these trend analyses and scatter plots for a multi-layered coastal system were compared with the chemical analyses of water samples and were found to be in close agreement. This approach would reduce drill-stem tests, which are costly and risky, and also minimize uncertainties in the assessment of quality variations for individual zones in multi-aquifer systems. (Author's abstract)
W91-00157

REMOTE-SENSING APPLICATION TO WELL MONITORING.
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W91-00169

MODELING THE EFFECT OF ALGAL BIOMASS ON MULTISPECIES AQUATIC MICROCOSMS RESPONSE TO COPPER TOXICITY.
Washington Univ., Seattle. Applied Physics Lab.
For primary bibliographic entry see Field 5C.
W91-00197

RURAL WATER SUPPLY INVESTIGATIONS IN SCARCITY VILLAGES IN BHANDARA DISTRICT, MAHARASHTRA.
Central Ground Water Board, Nagpur (India). Central Region.
P. R. Subramanian.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 71-74, 1 fig.

Descriptors: *Data collections, *Developing countries, *Geohydrology, *Groundwater resources, *Water resources development, *Water yield, Bhandara District, Geology, Gneiss, Granites, India, Mica, Well drilling.

Recurrent failure of monsoons since 1982 culminated in alarming drought condition in many parts of Maharashtra, India, especially in the Vidarbha region. Bhandra district was severely affected. Most of the district is underlain by rocks of Pre-Cambrian age belonging to Sausar and Sakoli series, comprised of mica-schists, quartz-mica-granualites and gneisses. The Sakoli group of rocks occur in a triangular fashion and are comprised essentially of agillaceous sediments with arenaceous intercalations, metamorphosed to varying degrees. Granites, granitic gneisses and basic intrusives and extrusives occurring and associated with the above rocks. The Central Ground Water Board carried out geohydrological surveys in 315 scarcity villages and selected sites for borewells, and tubewells. Drilling that has been carried out so far has indicated good yields ranging from 500 to 28,000 L/hr. (See also W91-00215) (Lantz-PTT)
W91-00222

APPLICATION OF RADIOACTIVE TRACER TECHNIQUES FOR DETERMINING GROUNDWATER VELOCITY AND DIRECTION.
Bhabha Atomic Research Centre, Bombay (India).
K. Shivanna, U. P. Kulkarni, S. V. Navada, and A. C. Eapen.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 75-88, 7 fig, 2 tab, 4 ref.

Descriptors: *Flow velocity, *Groundwater movement, *India, *Radioactive tracers, *Saline water intrusion, *Tracers, Aquifers, Case studies, Developing countries, Wells.

Single well tracer techniques for groundwater velocity measurement and multiple well techniques for determining the direction of groundwater flow were employed in the following groundwater studies. (1) Leakage of reservoir water in a lateritic area in Sawantvadi in Maharashtra: radiotracer studies were carried out at the Poip Dam site to investigate the seepage of reservoir water. It was observed that most of the seepage occurred from under the dam through the laterite soil in the direction of the natural stream at the dam's location. (2) Seawater intrusion in the Minjur aquifer near Madras in Tamil Nadu: A radiotracer study was carried out on the coastal Minjur aquifer to determine the intrusion of saltwater toward the well field. The inland intrusion of the saltwater was found to be a few centimeters per day near the coast. (3) Impact of paper mill effluent on the groundwater body at Erode in Tamil Nadu: A radio tracer carried out near M/s. Seshasayee Paper Mill in Erode helped in determining the rate at which effluents move toward the groundwater body. (See also W91-00215) (Lantz-PTT)
W91-00223

ENVIRONMENTAL CHLORIDE METHOD FOR GROUNDWATER RECHARGE STUDIES: POTENTIALITIES AND LIMITATIONS.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-00226

SPECIFIC YIELD ESTIMATIONS BY RADIOACTIVE TRACER IN INDO-GANGETIC PLAIN.
Uttar Pradesh Irrigation Research Inst. Roorkee (India).
For primary bibliographic entry see Field 2F.
W91-00227

MANAGEMENT AND CONSERVATION OF GROUND WATER RESOURCE THROUGH POINT DILUTION TECHNIQUE USING RADIOTRACER - SOME CASE HISTORIES.
For primary bibliographic entry see Field 4B.
W91-00229

SUBMERSIBLE PUMP TESTS CONDUCTED ON BORES DRILLED BY D.T.H. COMPRESSOR RIGS AND THE COMPARISON OF TWO DISCHARGES.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
For primary bibliographic entry see Field 2F.
W91-00232

INSTRUMENTATION AND TECHNIQUE OF GROUNDWATER EXPLORATION (WITH NATURE OF AQUIFER) IN UNCONSOLIDATED SEDIMENTS (GANGETIC PLAINS) OF UTTAR PRADESH, NORTHERN INDIA.
Lucknow Univ. (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00235

MORE ACCURATE DETERMINATION OF AQUIFER PARAMETERS USING THE IP SOUNDING METHOD.
University of Science, Penang (Malaysia).
S. Arafin, and C. Y. Lee.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 221-228, 5 fig, 1 tab, 14 ref.

Descriptors: *Aquifers, *Data acquisition, *Electrical studies, *Geohydrology, *Geophysical surveys, *Induced polarization, Geologic fractures, Groundwater movement, Hydraulic conductivity, Limestone, Resistivity, Transmissivity.

Unlike the DC resistivity method, the induced polarization (IP) method for the determination of the fractured limestone zones is seldom used in groundwater prospecting. A literature search shows that the IP method has been used intermittently over the last thirty years. An estimate of geohydrological parameters is based on the assumption that the so-called saturated layer contains clean sand and that there is no clay in the aquifer. In practice, such a situation is rarely encountered while prospecting for groundwater. The author attempts to show that the IP method can be used to identify the fractured limestone zones and separate the saturated layer from the clay layer. This is usually determined from the DC resistivity method. Therefore, the saturated thickness determined from the IP sounding curve is very likely to be more accurate. Consequently the estimate of the geohydrological parameter is close to the true representative value. This information can be used to estimate the transmissivity of limestone aquifers in the northwestern Peninsular Malaysia, from longitudinal conductance. (See also W91-00215) (Lantz-PTT)
W91-00238

INTEGRATED GEOLOGICAL AND GEOPHYSICAL INVESTIGATIONS FOR DELINEATING KARSTIC ZONES IN CARBONATE FORMATIONS OF ANANTAPUR DISTRICT, A.P., INDIA.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-00239

DECIPHERING GROUNDWATER USING REMOTE SENSING TECHNIQUES.
Roorkee Univ. (India). Dept. of Civil Engineering.
O. Prakash Dubey, S. Niwas, and P. Ahmed.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 269-272, 2 ref.

Descriptors: *Data acquisition, *Groundwater management, *Groundwater resources, *Remote sensing, Groundwater budget, Landsat, Model studies, Satellite technology, Water resources management.

For the optimal management of resources, an accurate and timely information system is required. Conventional data collection systems are often uneconomical, difficult, and slow. Remote sensing techniques can be organized in near real-time for the evaluation of water resources. An analysis is presented for the evaluation of groundwater resources in a part of the Indogangetic Plain in India. A linear mathematical model of a land cover system operator matrix has been developed for the evaluation of groundwater recharge. The operator has been estimated from the Landsat SST, band 5 and band 7, with imagery blowup at a scale of 1:250,000. The operator can be singular or nonsingular, square or rectangular. The model was calibrated using conventional Generalized Linear Inversion (GLI) and Moore Pen Rose Inverse (MPI) techniques; MPI gives better results. The model was used to predict the groundwater level fluctuations for 1977. The data generated from the model is consistent with actual observations. (See also W91-00215) (Lantz-PTT)
W91-00243

PROSPECTING GROUNDWATER IN PUSHKAR LAKE REGION THROUGH REMOTE SENSING - A CASE STUDY.
Roorkee Univ. (India). Dept. of Civil Engineering.
R. Sinha, and R. S. Tiwari.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 273-285, 4 fig, 13 ref.

Descriptors: *Case studies, *Data acquisition, *Data interpretation, *Groundwater resources, *India, *Pushkar Lake, *Remote sensing, Digital map data, Satellite technology.

The Puskar Lake Valley region of India was assessed for groundwater potential using remote sensing equipment, such as Landsat imagery. As a result of this investigation it was determined that useful information for delineating the potential zones for groundwater can be obtained using remote sensing techniques. The MSS data is good for extracting qualitative and quantitative information. Digital processing techniques have great potential for mapping the surface manifestations of groundwater occurrence to facilitate faster analysis. The interpretation also aids in inferring subsurface features. A detailed investigation of major zones identified through satellite data analysis is required before selecting sites for drilling wells. The analysis of areal photographs and the use of digital processing of the high resolution data are strongly recommended for obtaining concrete results. (See also W91-00215) (Lantz-PTT)
W91-00244

RADIAL VERTICAL ELECTRICAL SOUNDINGS: A CASE STUDY IN GROUNDWATER EXPLORATION.
Karnatak Univ., Dharwad (India). Dept. of Studies in Geology.
For primary bibliographic entry see Field 2F.
W91-00246

DEEP GEOELECTRICAL SOUNDINGS AND SHAPES OF CURVES USED FOR RECOMMENDATIONS OF BORE SITES IN BASALTIC TERRAIN.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
H. N. Parikh, A. J. Merh, and S. B. Singh.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 307-310, 1 fig, 8 ref.

Descriptors: *Boreholes, *Data acquisition, *Geoelectrical soundings, *Geophysical surveys, *Site selection, *Sounding, *Well drilling, Groundwater resources, Resistivity.

Geophysical methods provide an indirect picture of subsurface formations by measuring the various physical parameters of the earths' crust. These parameters are: density, magnetic susceptability, electrical conductivity and elasticity. An Electrical Resistivity Survey (ERS) is by far the most suitable method for groundwater investigation . The geoelectrical resistivity method used to collect resistivity values of surface to depth in a rock mass at a particular point is called Vertical Electrical Sounding (VES). The true resistivity values and thickness of layers are obtained from the interpretation of the sounding curves. The Schlumberger configuration was used in the VES that was conducted in the Jamnager district to select borehole sites in basaltic terrain. From this study the following recommendations were made: (1) Deep soundings are necessary for deep scanning of basalt rocks; (2) For deep scanning, the electrode should be placed 1000 m apart; (3) Cable wires and battery packs must be strong and leak proof; (4) Shapes of curves depend on various factors and do not guarantee large quantities of fresh water; (5) The resistivity meter should be accurate and fast working; and (6) A clear correlation of different data and observations should improve the drilling results. (See also W91-00215) (Lantz-PTT)
W91-00247

DESCRIPTION OF LINEAMENTS FOUND IN KALAVAD TALUKA OF JAMNAGAR DISTRICT AND DRILLING DRILLED FOR WATER SUPPLY.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
For primary bibliographic entry see Field 2F.
W91-00248

BRISK GROUND WATER INVESTIGATION FOR LOCATING BORE HOLE SITE IS BASALTIC TERRAIN.
Gujarat Water Resources Development Corp. Ltd., Rajkot (India). Ground Water Div.
For primary bibliographic entry see Field 2F.
W91-00249

ELECTRICAL RESISTIVITY SURVEY FOR GROUND WATER IN VARAHA RIVER BASIN, A.P., INDIA.
Andhra Univ., Waltair (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00251

STUDY OF SOIL MOISTURE MOVEMENT IN THE VADOSE ZONE USING NEUTRON PROBE.
National Geophysical Research Inst., Hyderabad (India).
R. Chand.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 359-369, 5 fig, 5 ref.

Descriptors: *Borehole geophysics, *Data acquisition, *Groundwater movement, *Neutron logging, *Neutron probes, *Soil water, *Vadose zone, Evaporation, Groundwater recharge, Infiltration, Infiltration rate, Rainfall-runoff relationships.

Neutron probing of soils is useful for assessing the soil moisture variation in the vadose zone. Results from field studies in alluvial soils probed to a depth of 250 cm during the pre-monsoon, monsoon, and post-monsoon periods, under both naturally and artificially ponded conditions, are addressed. Soil moisture data was plotted against the depth probed. Information rates and evaporation losses were calculated under different conditions. During the dry periods, the neutron probe provided data to compute actual evaporation. The studies also show that drainage losses for the soil studied are relatively small in the zones below 120 cm depth, and there is not much variation in moisture content below this depth. The velocity of infiltration and the velocity of drainage discharge in the profile varied with time. But the velocity of vertical flow over the distance between the centers of consecutive layers was found to be constant during one time interval. The infiltration rate was about 9.8 mm/hr immediately after ponding, and increased to 23.3 mm/hr within 3 to 4 hours, remaining about 18.7 mm/hr until the ponding height reduced to zero. During this period of four hours after ponding, the soil moisture storage increased by 15.35 cm and absorbed 98% ponded water. Evaporation during the period April 22 to May 22, and May 22 to June 21, 1985 was estimated to be 5 cm and 1.9 cm, respectively. (See also W91-00215) (Lantz-PTT)
W91-00256

SOIL MOISTURE STUDIES IN SOILS OF DELHI TERRITORY USING THE RESISTIVITY METER.
Indian Agricultural Research Inst., New Delhi. Nuclear Research Lab.
For primary bibliographic entry see Field 2G.
W91-00258

BOREHOLE RESISTIVITY LOGGING IN PVC SCREENED WELL.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-00264

CROSS-SECTIONAL VARIABILITY IN SUSPENDED SEDIMENT AND ASSOCIATED TRACE ELEMENT CONCENTRATIONS IN SELECTED RIVERS IN THE US.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2J.
W91-00287

CASE STUDY OF APPROACHES FOR DETERMINING DIFFUSE SUSPENDED SEDIMENT SOURCES AND PROCESSES.
Alberta Research Council, Edmonton. Resource Technologies Dept.
For primary bibliographic entry see Field 2J.
W91-00290

SEDIMENT STORAGE AND MOVEMENT ON THE SOUTHERN HIGH PLAINS OF TEXAS AS INDICATED BY BERYLLIUM-TEN.
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 2J.
W91-00299

APPLICATION OF GEOPHYSICAL METHODS TO HYDROGEOLOGICAL PROBLEMS IN DINARIC KARST OF YUGOSLAVIA.
Geophysical Institute, Belgrade, Yugoslavia.
D. Arandelovic.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 143-159, 10 fig, 7 ref.

Descriptors: *Aquifer systems, *Borehole geophysics, *Data acquisition, *Engineering geology, *Geohydrology, *Geophysical methods, *Geophysical surveys, *Karst, *Regional Aquifer-Systems Analysis, *Yugoslavia, Dinaric Karst, Field tests, Geologic formations, Groundwater, Groundwater movement, Karst hydrology.

Geophysical methods applied in the Yugoslavian karst areas include electrical sounding, electrical mapping, mise a la masse, seismic refraction, ultrasonic impulse, GEOBOMB, and well-logging. The following problems in the Dinaric Karst Region were solved using geophysical methods: (1) determination of depth of the karstified base; (2) determination of the position of intensively karstified and tectonically broken zones in karstified limestone; (3) delimitation of the intrusion of saline water and its water table; (4) recognition of boundaries of the fresh water zone in brackish karst areas; (5) study of the intensity of karstification and position of water bearing zones in boreholes; (6) detection of potential or existing groundwater flows; (7) determination of direction and rate of groundwater flow by a single well; and (8) estimation of porosity and permeability of karstic rocks. Field examples illustrating the role of geophysical methods included identification of groundwater supply for the Marina-Stupin Valley, determination of groundwater flow in the Oko Spring area, determination of the karstified base and the thickness of sediments in the Fatnicko Polje in Herzegovina, a study of the karstified base and the position of intensively karstified and tectonically damaged zones in the area of the Bileca Storage Reservoir, and exploration of the Grancarevo and Mratinje Dam sites. (See also W91-00318) (MacKeen-PTT)
W91-00326

COST EFFECTIVENESS OF THE STREAMFLOW-GAGING PROGRAM IN WEST VIRGINIA.
Geological Survey, Charleston, WV.
For primary bibliographic entry see Field 2E.
W91-00331

SELECTED QUALITY ASSURANCE DATA FOR WATER SAMPLES COLLECTED BY THE U.S. GEOLOGICAL SURVEY, IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO, 1980 TO 1988.
Geological Survey, Idaho Falls, ID. Water Resources Div.
S. J. Wegner.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4168, October 1989. 91p, 4 fig, 24 tab, 12 ref.

Descriptors: *Chemical analysis, *Data quality control, *Idaho, *Laboratories, *Quality assurance, *Water analysis, *Water quality data, Groundwater quality, Statistical analysis, Surface water data, Water quality, Water sampling, Well water.

Multiple water samples from 115 wells and 3 surface-water sites were collected between 1980 and 1988 for the ongoing quality assurance program at the Idaho National Engineering Laboratory. The reported results from the six laboratories involved were analyzed for agreement using descriptive statistics. The analytical constituents and properties included: tritium, plutonium-238, plutonium-239, -240 (undivided), strontium-90, americium-241, cesium-137, total dissolved chromium, selected dissolved trace metals, sodium, chloride, nitrate, selected purgeable organic compounds, and specific conductance. Agreement could not be calculated for trace metals, some nitrates, purgeable organic compounds, and blank-sample analyses because analytical uncertainties were not consistently reported. However, differences between results for most of these data were calculated. The blank samples were not analyzed for differences. The laboratory results analyzed using descriptive statistics showed a median agreement of 95% between all usable data pairs. (Author's abstract)
W91-00334

COMPARISON OF TRACER-DILUTION AND CURRENT-METER DISCHARGE MEASUREMENTS IN A SMALL GRAVEL-BED STREAM, LITTLE LOST MAN CREEK, CALIFORNIA.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-00337

EVALUATION OF METHODS USED FROM 1965 THROUGH 1982 TO DETERMINE INORGANIC CONSTITUENTS IN WATER SAMPLES.
Geological Survey, Reston, VA.
L. C. Friedman, and M. J. Fishman.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Supply Paper 2293. 126p, 83 fig, 27 ref.

Descriptors: *Chemical analysis, *Inorganic compounds, *Laboratory methods, *Water analysis, *Water chemistry, *Water samples, Analytical methods, Comparison studies, Hydrologic data, Performance evaluation, Precision.

Since 1962, the U S Geological Survey has prepared and distributed standard Reference Water Samples (SRWS) to participating laboratories in order to alert them to possible analytical deficiencies. This report marks the first time that a concentrated effort has been made to examine and compare the SRWS data for each constituent by the analytical method that was used to obtain the data. Unlike laboratories that participate in interlaboratory studies that are designed to determine the precision and accuracy of a particular analytical method, laboratories that participate in the SRWS program are allowed to select the method used to analyze a reference sample and are requested to report the method used. Data for a particular method could not be compared with a 'true' value because the data were obtained from analyses of reference samples that were prepared using natural waters; however, where possible a comparison was made between the mean concentrations obtained by the various analytical methods that were used to determine each constituent. Where enough information is available, models for predicting the precisions of the methods have been developed, and the precisions have been compared. In addition to the data presented in the reports, this evaluation provides a good indication of methods that were used routinely to analyze water samples during the 18 years of study. (Author's abstract)
W91-00350

RESULTS OF QUALIFICATION TESTS ON WATER-LEVEL SENSING INSTRUMENTS, 1987.
Geological Survey, Stennis Space Center, MS.
T. E. Olive.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 89-397, 1989. 37p, 8 fig, 11 tab, 9 ref.

Descriptors: *Instrumentation, *Measuring instruments, *Performance evaluation, *Water level, Test facilities, Testing procedures.

The U S Geological Survey's Hydrologic Instrumentation Facility (HIF) at the Stennis Space Center, Mississippi, conducts qualification tests on water-level sensing instruments. Instrument systems, which meet or exceed the Survey's minimum performance requirements, are placed on a Qualified Products List. The qualification tests conducted in the environmental chamber at the HIF's Test and Evaluation Laboratory in 1987 added two instrument systems to the Qualified Products List. The Leupold and Stevens water-level sensing system, consisting of the PG-III pulse generator, Telemark II encoder, and an environmental modem met or surpassed the requirements for use at a daily-discharge station. The Endeco model 1029 solid-state memory water-level recorder systems met or surpassed the requirements for a special-case station. These systems have been added to the Qualified Products List for water-level sensing instrument systems as a result of these tests. The laboratory qualification tests were conducted by the HIF's Test and Evaluation Section Section, using one model of each system. The first test on each system was made at prevailing room tempera-

ture and humidity conditions. This was a bench test to familiarize personnel with system operation and to test instrument output at a constant input. The calibration of each instrument was checked in the second test, using procedures appropriate for that type of system. Environmental tests were run to establish the system performance under simulated field conditions. The last test was a calibration check for drift in the instrument's output over the qualification testing period. (Author's abstract)
W91-00356

SOIL-GAS SURVEYING FOR SUBSURFACE GASOLINE CONTAMINATION USING TOTAL ORGANIC VAPOR DETECTION INSTRUMENTS: PART I. THEORY AND LABORATORY EXPERIMENTATION.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5A.
W91-00368

REMOTE DATA COLLECTION AND CONTROL FOR HYDROGEOLOGIC MONITORING.
CH2M Hill Engineering, Waterloo (Ontario).
M. Adomait, and R. W. Gillham.
Ground Water Monitoring Review GWMRDU, Vol. 10, No. 3, p 138-142, Summer 1990. 6 fig, 10 ref.

Descriptors: *Data acquisition, *Data storage and retrieval, *Geohydrology, *Groundwater movement, *Hydrologic data, *Microcomputers, *Monitoring, *Telemetry, Computers, Data transmission, On-site data collections.

The use of microcomputers for remote control applications is well established in industry. This technology was adaptated for experiment control and data collection for hydrologic monitoring at remote sites. A hydrogeologic field experiment, conducted at a research site some 125 miles (200 km) from the home base, used commercially available computer controller technology for data collection and experimental control. A telephone line connected to the equipment facilitated the downloading of data, provided a means of remotely monitoring the operating performance, and made it possible to adjust the monitoring procedures. This experiment demonstrated the benefits of a remotely controlled data acquisition system for a long-term investigation. Identification of problems and the adjustment of the sampling algorithm by telephone reduced costly travel time. The considerable amount of data collected, the data evaluation techniques, and the continuous monitoring provided a high degree of confidence in the results. (Author's abstract)
W91-00370

ACCURACY OF HYDRANT FLOW TESTS USING A PITOT DIFFUSER.
Wyoming Valley Sanitary Authority, Wilkes-Barre, PA.
T. M. Walski, and T. L. Lutes.
Journal of the American Water Works Association JAWWA5, Vol. 82, No. 7, p 58-61, July 1990. 6 fig, 4 ref.

Descriptors: *Diffusers, *Flow equations, *Flow measurement, *Flow models, *Hydrants, *Hydraulics, *Water distribution, Hydraulic models, Mathematical analysis, Mathematical equations, Mathematical models, Rapid flow, Water delivery.

Hydrant flow tests are important for collecting data for pipe network model calibration and assessing the general strengths and weaknesses of a water distribution system. The method of choice for measuring discharge from a hydrant is the hydrant Pitot gauge. However, the strong, directed flow from such a gauge can result in damage because of erosion, flooding or impact. Several devices, referred to as Pitot diffusers, have been developed to divert and diffuse the flow to minimize such damage and disruption. Attempting to apply formulas developed for freely discharging streams to Pitot diffusers can give poor estimates of discharge because flow in the throat of the diffuser tested more closely corresponded to closed conduit flow. With total and static pressure readings, Pitot diffuser devices can give good results using the formulas developed in this work. If only total pressure is measured, somewhat more complicated formulas are needed for the same accuracy. Numerical values for coefficients given here are only applicable to identical Pitot diffusers. (Hoskin-PTT)
W91-00378

DETERMINATION OF CHLOROANILINE TRACES IN ENVIRONMENTAL WATERS BY SELECTIVE EXTRACTION WITH TWO TRAPS IN TANDEM AND LIQUID CHROMATOGRAPHY.
Rome Univ. (Italy). Dipt. di Chimica.
For primary bibliographic entry see Field 5A.
W91-00389

AUTOMATED HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY FOR THE DETERMINATION OF PESTICIDES IN WATER USING SOLID PHASE EXTRACTION.
Brock Univ., St. Catharines (Ontario). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-00390

PERFORMANCE EVALUATION MATERIALS FOR THE ANALYSIS OF VOLATILE ORGANIC CONTAMINANTS IN SOIL: A PRELIMINARY ASSESSMENT.
Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W91-00393

PRELIMINARY ASSESSMENT OF THE POTENTIAL FOR USING CESIUM-137 TO ESTIMATE RATES OF SOIL EROSION IN THE LOESS PLATEAU OF CHINA.
Xian Lab. of Loess and Quaternary Geology (China).
For primary bibliographic entry see Field 2J.
W91-00405

SPATIAL ALLOCATION FACTOR PROCEDURES FOR THE 1980 NAPAP (NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM) EMISSIONS INVENTORY DOCUMENTATION.
Alliance Technologies Corp., Bedford, MA.
For primary bibliographic entry see Field 5B.
W91-00453

REMOTE SENSING AND LARGE-SCALE GLOBAL PROCESSES.
IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. 191 p. Edited by Albert Rango.

Descriptors: *Climatology, *Meteorology, *Remote sensing, *Satellite technology, Evapotranspiration, Ice, Instrumentation, Precipitation, Snow, Symposium.

Twenty-one papers presented at a symposium held during the Third Scientific Assembly of the International Association of Hydrological Sciences in 1989 are included in this proceedings. The papers are divided into five areas as follows: (1) large-scale processes (5 papers); (2) evapotranspiration (4 papers); (3) precipitation (4 papers); (4) ice, snow, and climate (4 papers); and (5) remote sensing (4 papers). (See W91-00455 thru W91-00475) (Peters-PTT)
W91-00454

HYDROLOGICAL REMOTE SENSING RESEARCH WITH LARGE-SCALE APPLICATIONS IN WESTERN EUROPE.
Zurich Univ. (Switzerland). Remote Sensing Labs.
H. Haefner.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 3-12, 40 ref.

Descriptors: *Europe, *Rainfall-runoff relationships, *Remote sensing, *Satellite technology, *Snow cover, *Snowmelt, Alps, Finland, Glaciers, Glaciohydrology, Greenland, Hydroelectric plants, Instrumentation, Mapping, Microwaves, Norway, Optical properties, Surface water availability, Switzerland.

Water which was taken for granted and as existing in infinite abundance has become one of our most precious natural resources. Accordingly the need to assess and forecast water supplies increases rapidly. Remote sensing methods are being used more and more to overcome these problems and to acquire near-real-time data in regular temporal sequences to measure, monitor and model the complex hydrological processes in the environment. Hydrological properties are strongly interlinked with processes at the surface of the earth and in the atmosphere, influencing environment and climate. Within this wide spectrum of research topics and practical applications, the main emphasis is given to the specific requirements of Western Europe, dealing exclusively with processes in which land surfaces and inland waters are involved. Consequently large-scale applications, requiring high standards of accuracy, predominate in this review. Examples are provided for runoff forecasting of rainfall and from the snow cover. Operational applications are dominant in the field of snow hydrology; preference is being given to optical data and low-cost (PC based) classification systems. Snow mapping for runoff forecasting to optimize hydroelectric power generation is undertaken for example in the Swiss Alps, in Norway and in Greenland. Extensive research activities on the possibilities and applications of microwave sensors are being carried out in the Alps and Finland. The results indicate that the prospects for an adequate microwave system for snow hydrology, especially for large-scale mapping, are not too promising. Efforts need to be undertaken to develop integral models considering all sources of precipitation and capable of simulating and forecasting the entire runoff regime of a basin. (See also W91-00454) (See also W91-00454) (Peters-PTT)
W91-00455

HAPEX-MOBILHY: RESULTS FROM A LARGE-SCALE FIELD EXPERIMENT.
Centre National de Recherches Meteorologiques, Toulouse (France).
J. C. Andre, J. P. Goutorbe, T. Schmugge, and A. Perrier.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 13-20, 2 fig, 2 tab, 9 ref.

Descriptors: *Evapotranspiration, *Infrared imagery, *Remote sensing, *Thermal radiation, Aircraft, Cropland, Instrumentation, Microwaves, Soil moisture, Temperature, Transpiration.

The HAPEX-MOBILHY program is aimed at studying the hydrological budget and evapotranspiration flux at the scale of the GCM grid, i.e., 10000 sq km. For the program several surface and subsurface networks operated from mid 1985 to early 1987 to measure and monitor soil moisture, surface energy budget, and surface meteorological parameters. During the Special Observing Period (SOP) from May 7 to July 15 1986, there were additional measurements including detailed observation of atmospheric fluxes and remote sensing of the surface using two well instrumented aircraft: the NCAR King-Air for flux measurements and the NASA C-130 aircraft for remote sensing observations. The NASA aircraft carried a thermal infrared multispectral scanner (TIMS) for surface temperature observations. Surface temperature maps were created using the TIMS data to study the representativeness of the surface flux measurements stations (SAMER). The SAMER stations were located in cultivated fields which at the time of the aircraft overflights were mostly bare. The histograms of the total scenes ranged from 25-30 C for the freely transpiring vegetated surfaces to

more than 40 C for the bare soils; most of the temperatures for the SAMER stations were in the 40 C category. While the proportions of vegetated and bare surfaces varied from scene to scene, they typically were about evenly split. These results have implications for the comparison of aircraft and surface flux measurements. In the situation examined, the majority of the area had a surface temperature typical of the forest, the flux measured by the King-Air would be close to that measured by a forest tower. (See also W91-00454) (Peters-PTT)
W91-00456

USE OF SATELLITE MICROWAVE RADIOMETERS FOR LARGE-SCALE HYDROLOGY.
Innsbruck Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
H. Rott, and J. Aschbacher.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 21-30, 3 fig, 22 ref. Austrian Fonds zur Forderung der Wissenschaftlichen Forschung, Project No. S3801.

Descriptors: *Microwaves, *Remote sensing, *Satellite technology, *Snow cover, *Soil water, Instrumentation, Mapping.

Microwave radiometers on earth-orbiting satellites are able to make significant contributions to large-scale observations of hydrological parameters. Promising applications include rainfall mapping, soil moisture monitoring, and mapping of snow areal extent and water equivalent. Constraints for retrievals of these parameters result from complex interactions of microwave radiation with various physical properties of targets and from limited spectral capabilities and spatial resolution of existing microwave sensors. These constraints can partly be overcome by utilizing support information from other sensors. The capabilities of satellite microwave sensors for soil moisture and snow cover sensing are illustrated using examples of Nimbus-7 Scanning Multichannel Microwave Radiometer data. Due to complex interactions of microwave radiation with physical properties of the targets, the retrieved information from microwave sensors will not be able to cope with detailed in situ measurements for small scale applications. The strength of microwave radiometry is the repetitive coverage of large areas. (Peters-PTT)
W91-00457

FIRST ISLSCP FIELD EXPERIMENT: EXPERIMENT EXECUTION AND PRELIMINARY ANALYSES.
Maryland Univ., College Park.
P. J. Sellers, J. L. Dorman, C. Walthall, F. G. Hall, and D. E. Strebel.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 49-58, 8 fig, 13 ref.

Descriptors: *Evaporation, *Remote sensing, *Satellite technology, *Transpiration, *Vegetation effects, Canopy, Data acquisition, Data interpretation, Grasslands, Instrumentation, Kansas, Radiometry, Soil moisture, Temperature.

Progress in the First ISLSCP Field Experiment (FIFE) is reviewed. FIFE was executed in May-October 1987 and involved the detailed study of land surface-atmosphere exchanges over a 15 x 15 km grassland area in Kansas. The objective of the experiment was to determine the extent to which surface parameters could be quantified from remotely sensed data. The analysis of data is underway: It appears that the use of radiometric surface temperature has a limited capability for the calculation of surface sensible heat fluxes. Vegetation index data, on the other hand, shows some promise for the calculation of surface latent heat fluxes and photosynthetic rates. Additionally, many of the biophysical relationships linking photosynthesis to transpiration appear to show little variation across a wide range of measurement scales. (See also W91-00454) (Author's abstract)
W91-00460

RELATING NIMBUS-7 GHZ DATA TO LAND SURFACE EVAPORATION.
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
B. J. Choudhury.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 59-66, 3 fig, tab, 13 ref.

Descriptors: *Evaporation, *Remote sensing, *Satellite technology, *Temperature effects, Air temperature, Data acquisition, Data interpretation, Hydrologic budget, Instrumentation, Vegetation effects.

Land surface evaporation links the heat and the water balances, and this process has been shown to have a significant impact on the regional and global atmospheric circulation patterns. An attempt was made to relate the 37 GHz brightness temperatures observed from the Nimbus-7 satellite to the land surface evaporation. The spatial resolution of the global 37 GHz data is 0.25 degrees x 0.25 degrees (latitude x longitude), gridded on a Mercator projection. The data have been processed for 84 consecutive months, January 1979 to December 1985. Limited field observations and radiative transfer modeling for agricultural crops show that the temporal variation of these data could be related to crop phenology (leaf growth and senescence). A radiative transfer model and empirical data were used to investigate the relationship between the 37 GHz observations and evaporation. A logarithm relation provided a good correlation between the annual evaporation and the annual mean change in temperature. (See also W91-00454) (Author's abstract)
W91-00461

RELATIONSHIPS BETWEEN THE HYDROLOGIC BALANCE OF A SMALL WATERSHED AND REMOTELY SENSED SOIL MOISTURE.
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2A.
W91-00463

POTENTIAL APPLICATION OF SATELLITE DATA FOR RAINFALL ESTIMATION.
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2B.
W91-00465

RADAR DATA PROCESSING FOR HYDROLOGY IN THE CEVENNES REGION.
Laboratoire Central des Ponts et Chaussees, Bouguenais (France).
H. Andrieu, J. D. Creutin, G. Delrieu, J. Leoussoff, and Y. Pointin.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 105-115, 5 fig, 2 tab, 16 ref.

Descriptors: *Alpine regions, *Flood forecasting, *Instrumentation, *Mountains, *Radar, *Rainfall-runoff relationships, Cevennes, Data interpretation, Data processing, Errors, Flash floods, France, Rain gages.

An experiment called 'Cevennes 86-88' was designed to evaluate weather radar capabilities for a flash flood early warning system in a mountainous area. A dual polarization radar was set up, during the Autumn seasons from 1986 to 1988, in the heart of the mountain ridge in Barre des Cevennes at a 1030 m elevation. At the same time, hydrological and meteorological data from 45 recording rain gages covering 6,000 sq km were analyzed and archived. Radar data processing procedures were developed to detect and correct for anomalies (ground clutter and underdetection) caused by the mountainous relief in order to provide suitable rainfall estimates for hydrological applications. The preliminary results obtained indicate the important role of radar data processing in mountainous terrain. On-going research efforts are being devoted to the validation of radar assessments on the complete database and the introduction of radar information in flow forecasting models. (See also W91-00454) (Peters-PTT)
W91-00466

MONITORING OF WEATHER CONDITIONS ON MESOSCALE TO IMPROVE A PRECIPITATION WARNING SYSTEM FOR HYDROLOGIC PURPOSES.
Kozponti Elorejelzo Intezet, Budapest (Hungary).
A. Takacs.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 117-123, 5 fig, 10 ref.

Descriptors: *Hungary, *Meteorology, *Radar, *Rainfall, *Weather forecasting, Data processing, Model studies, Nowcasting, Rainfall intensity, Rainstorms.

Extreme rainfall over a small area and during a very short time can be predicted up to 2 hr ahead by extrapolation using radar and satellite measurements and conventional meteorological data. For prediction, large amounts of observational data have to be processed and the resulting products distributed to the users very quickly because of the nature of the information. The meteorological considerations for developing a precipitation warning system for hydrological purposes in Hungary were examined. Because of the short time available for prediction a method was developed for making preliminary estimations based on conventional meteorological data. First guess estimations are made more exact by monitoring of weather conditions on mesoscale by use of hourly surface measurements and manually digitized radar data. The precipitation warming system is being developed on a personal computer by the use of a displaying technique. (See also W91-00454) (Author's abstract)
W91-00467

SATELLITE DETERMINATION OF COAST RANGE, ALASKAN GLACIER MASS BALANCE RELATED TO ATMOSPHERIC CIRCULATION.
Maine Univ. at Orono. Inst. for Quaternary Studies.
For primary bibliographic entry see Field 2C.
W91-00468

DETERMINATION OF SNOW WATER EQUIVALENTS BY USING NOAA-SATELLITE IMAGES, GAMMA RAY SPECTROMETRY AND FIELD MEASUREMENTS.
Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).
For primary bibliographic entry see Field 2C.
W91-00470

MULTISPECTRAL SNOW AREA ALGORITHM FOR OPERATIONAL 7-DAY SNOW COVER MONITORING.
Bristol Univ. (England). Remote Sensing Unit.
For primary bibliographic entry see Field 2C.
W91-00471

HYDROLOGICAL EFFECTS OF CATCHMENT CHARACTERISTICS AND LAND USE CHANGES DETERMINED BY SATELLITE IMAGERY AND GIS.
Ruhr Univ., Bochum (Germany, F.R.). Inst. for Hydrology, Water Resources and Environmental Engineering.
For primary bibliographic entry see Field 2A.
W91-00472

MONITORING LAKE NASSER BY SPACE SENSING.
Boston Univ., MA. Center for Remote Sensing.
E. B. Farouk.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 177-181, 1 fig, 4 ref.

Descriptors: *Lake Nasser, *Landsat images, *Nile River, *Remote sensing, *Satellite technology, *Water level, Drought, Egypt, Groundwater potential, Irrigation water, Monitoring, Reservoirs, Water conservation, Water resources management.

The level of Lake Nasser is a good indicator of the cycles of wet climate followed by droughts in East Africa. The dam has already saved Egypt from two cycles of dangerous floods in 1964 and 1975 and droughts in 1973 and 1984, and most perilously in 1987-1988. Recent changes in the water levels of Lake Nasser were clearly indicated by Landsat images and photographs obtained by the Space Shuttle astronauts and the Large Format Camera. Regular monitoring from space of the Lake's water level would constitute an early warning system of the conditions in the upper reaches of the Nile. In addition to monitoring that would allow better forecasting of Nile water levels several steps could be taken to help control the water situation in Egypt: (1) enforce water conservation measures; (2) pump and utilize the vast amounts of near-surface groundwater; and (3) search for and develop deep groundwater resources for use during time of need. Images obtained from Landsat and SPOT satellites can be used for future monitoring of the flow of the Nile into Lake Nasser. Since such satellites provide digital data, these can be processed in a nearly automated way to emphasize short-term changes. These data could also be used in long-term forecasting which is essential to the economic stability of the countries in East Africa. (See also W91-00454) (Peters-PTT)
W91-00473

FLOOD MONITORING FROM SPACE IN CHINA.
Ministry of Water Resources, Beijing (China). Remote Sensing Application Center.
J. Yang.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 183-185, 1 tab, 2 ref.

Descriptors: *China, *Flood forecasting, *Remote sensing, *Satellite technology, Flood damage, Historic floods, Land use, Runoff, Snowmelt, Snowpack, Soil erosion.

Flooding and soil erosion are problems in the fertile flood plains of eastern China. Remote sensing offers the opportunity to monitor floods and to identify land-use policies which exacerbate flooding conditions. Meteorological satellites and earth resources satellites are now being utilized to make areal measurements on a repetitive basis in flood prone regions. One of China's largely untapped resources is its unparalleled historical record collection; historical records of flooding events are available for the past 2200 years. These records are being examined to determine if trends or cycles are evident. Conventional observations should be continued and enhanced by employing spaceborne observations which sample entire areas rather than single points. This will result in an increase in agricultural productivity and a decrease in loss of life. (See also W91-00454) (Peters-PTT)
W91-00474

SATELLITE TELETRANSMISSION: TECHNOLOGY APPLIED TO HYDROLOGICAL FORECASTING. AN EXAMPLE OF THE FIGHT AGAINST ONCHOCERCOSIS (LA TELETRANSMISSION PAR SATELLITE: UNE TECHNOLOGIE ADAPTEE A LA PREVISION HYDROLOGIQUE. EXEMPLE DE LA LUTTE CONTRE L'ONCHOCEROSE).
Institut International de Recherche Scientifique pour le Developpement d'Adiopodoume, Abidjan (Cote d'Ivoire). Lab. d'Hydrologie.
E. Servat.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 187-191, 3 ref.

Descriptors: *Data acquisition, *Data transmission, *Public health, *Rapid flow, *Satellite technology, *Telemetry, *Tropical regions, *Water level, Africa, Hydrologic data, Larvicides, Onchocercosis, Parasites.

River blindness (onchocercosis) which is transmitted to man by the bite of a small fly, Simulium damnosum, is endemic in many areas of West Africa. A program was launched in 1974 by the World Health Organization to fight onchocercosis by destroying the larva of the simulium. Larvae develop in rivers, particularly in reaches with a rapid current, and are most susceptible to the effects of the larvicide when the water level is high. In 1985 a project was undertaken to optimize the application of the larvicide by applying it during periods of high river level and in areas having a fast current. Because of the large area to be covered, it was decided to obtain the required data by installing hydrological platforms fitted with transmitting devices. The collected data is transmitted every 220 seconds and picked up by a satellite that makes several passes each day over the area. The satellite, in turn, relays the data to a receptor station where the messages are stored and can be accessed by a human operator. This method has the following advantages: (1) access to the hydrological data regardless of season; (2) transmission of data on the water level in real time because the satellites relay the data a few times each day; and (3) fast centralization of data by communication among the receptor stations. The use of this data resulted in saving $2 million in 1987 through more efficient dosage of larvicide with respect to both quantity and timing. The program is being expanded by completing the installation of the hydrological platforms. At its completion, the network should include 100 platforms. This method of data collection and transmission by satellite can be used in the case of networks extended over substantial areas and could provide better management and automated surveillance of water resources. (See also W91-00454) (Peters-PTT)
W91-00475

CURRENT STATUS OF DISINFECTANT RESIDUAL MEASUREMENT METHODS FOR FREE AND COMBINED CHLORIDE AND OXYCHLORINE SPECIES.
Miami Univ., Oxford, OH. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-00479

FISH HEPATOCYTE MODEL FOR INVESTIGATION OF THE EFFECTS OF TRIHALOMETHANES.
Environmental Research Lab., Narragansett, RI.
S. M. Baksi.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 341-346, 4 tab, 5 ref.

Descriptors: *Bioindicators, *Biological studies, *Chlorination, *Laboratory methods, *Toxicology, *Trihalomethanes, *Water pollution effects, *Water treatment, Culturing techniques, Data acquisition, Hepatocytes, Model studies, Tissue analysis.

There is currently great concern over the potential health and environmental effects of the water chlorination reaction by-products, of which little is known toxicologically. A new application is presented for the isolated teleost hepatocyte culture system for examining the toxicity of these substances in aquatic species. The system holds great potential because of its sensitivity. Additionally, several endpoints (e.g. enzyme leakage, protein synthesis, and levels of specific proteins of interest) can be measured simultaneously. The hepatocyte culture system can potentially be used to investigate genetic effects and metabolism. In these preliminary experiments, a dose response relationship for trihalomethanes (THMs) was established, as well as the measurement of a cellular response--inhibition of protein synthesis--in response to exposure to THMs. The effect of bromine substitution on toxicity was clearly demonstrated. These types of experiments can be utilized to determine structure-activity relationships and further characterize the effect of bromine substitution on the mode of action and metabolism of chlorination reaction by-products. (See also W91-00476) (Lantz-PTT)
W91-00503

IDENTIFICATION OF ORGANIC N-CHLORAMINES IN WASTEWATER.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5A.
W91-00533

CHLORINE AND MONOCHLORAMINE MEASUREMENTS USING A PULSED SILVER IODIDE ELECTRODE.
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-00536

CHLORAMINE INTERFERENCE IN THE MEASUREMENT OF FREE CHLORINE BY THE AMPEROMETRIC MEMBRANE ELECTRODE.
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
J. N. Jenson, C. Le Cloirec, and J. D. Johnson.
IN: Water Chlorination: Chemistry, Environmental Impact and Health Effects. Volume 6. Proceedings of the Sixth Conference on Water Chlorination: Environmental Impact and Health Effects, Oak Ridge, Tennessee, May 3-8, 1987. Lewis Publishers, Inc., Chelsea, Michigan. 1989. p 801-808, 1 fig, 3 tab, 17 ref. EPRI Grant No. RP2300-7.

Descriptors: *Amperometry, *Chlorination, *Electrodes, *Measuring instruments, *Pollutant identification, *Wastewater treatment, *Water analysis, *Water treatment, Chloramines, Chlorine, Performance evaluation.

Chlorine reacts with water, ammonia and nitrogenous organics to form free available chlorine (FAC = HOCl + OCl), inorganic chloramines (mono, di and trichloramine), and organic chloramines (for example, N-chloramino acids). Chlorine is continually discharged in large quantities into the environment, after use in wastewater and drinking water treatment, as well as biofouling control in powerplant cooling towers. Interference by organic chloramines in the measurement of free available chlorine by an amperometric membrane electrode are addressed here. This study suggests that interference is significant with several chloramines, and instrument responses are 1 to $>$ 50 times the true HOCl concentrations. Comparisons between the hydrolysis constants calculated here with literature values indicates that in some instances, previously determined hydrolysis constants may be too large due to interferences in the free chlorine measurements. Results with model compounds were found to be consistent with the amperometric membrane electrode performance in the field. (See also W91-00476) (Lantz-PTT)
W91-00537

ENHANCEMENT OF THE HWRIC DATABASE, YEAR 2. WITH AN EVALUATION OF DATABASE CONTENT.
Illinois State Water Survey Div., Champaign. Ground-Water Section.
For primary bibliographic entry see Field 7C.
W91-00571

MECA WORKSHOP ON ATMOSPHERIC H2O OBSERVATIONS OF EARTH AND MARS.
Available from the National Technical Information Service, Springfield, VA 22161, as N89-25790. Price codes: A05 in paper copy, A01 in microfiche. Proceedings of the Workshop held September 25-27, 1986. LPI Technical Report No. 88-10, 1988. 95p. Edited by Stephen M. Clifford and Robert M. Haberle.

Descriptors: *Atmospheric water, *Data acquisition, *Remote sensing, *Soil water, *Workshops,

Astronomy, Hydrologic budget, Physical properties, Regoliths.

On September 25-27, 1986, a three-day MECA workshop on 'Atmospheric H2O Observations of Earth and Mars: Physical Processes, Measurements, and Interpretation' was held at the Lunar and Planetary Institute. The purpose of the workshop was to investigate and discuss a variety of ideas related to the detection and cycling of atmospheric H2O. Among ideas discussed were possible factors governing the storage and exchange of H2O between planetary surfaces and atmospheres; the instruments that may be best suited for measuring and mapping atmospheric H2O; the question of whether regolith sources and sinks of H2O have uniquely identifiable column abundance signatures; the degree of time and spatial resolution in column abundance data that may be necessary to determine dynamic behavior; and, whether or not current understanding of how atmospheric H2O is cycled on Earth provides any insight for the interpretation of Martian atmospheric data. These questions were addressed by researchers from fields as diverse as soil physics, atmospheric dynamics, atmospheric H2O instrumentation, and Martian volatiles. The interdisciplinary approach gave scientists from traditionally isolated disciplines a unique opportunity to meet and discuss issues of common interest. Of particular importance was the participation of scientists from the terrestrial community, whose perspective contributed to an improved understanding of the Mars water cycle. This technical report is the final product of that discussion. (See W91-00581 thru W91-00581) (Lantz-PTT)
W91-00576

OBSERVATIONS OF ATMOSPHERIC WATER VAPOR WITH THE SAGE II INSTRUMENT.
SASC Technologies, Inc., Hampton, VA.
J. C. Larson, M. P. McCormick, L. R. McMaster, and W. P. Chu.
IN: MECA Workshop on Atmospheric H2O Observations of Earth and Mars. Proceedings of the Workshop held September 25-27, 1986. LPI Technical Report No. 88-10, 1988. p 62-66, 3 fig, 8 ref. NASA Contract NASI-17022.

Descriptors: *Atmospheric water, *Data acquisition, *Measuring instruments, *Remote sensing, *Satellite technology, *Stratospheric Aerosol and Gas Experiment, Climatology, Meteorology, Nitrogen compounds, Ozone, Spectrometry.

The Stratospheric Aerosol and Gas Experiment II (SAGE II) is a multiwavelength spectrometer which infers the vertical distribution of atmospheric aerosols, ozone, nitrogen dioxide and water vapor from the extinction of solar radiation measured during space craft sunrise/sunset. Each day, 15 sunrise and 15 sunset profiles are obtained with successive measurements separated by 24 degrees in longitude at similar latitudes. Since this is the first measurement of water vapor with the SAGE II observational technique, and the first use of the water vapor band to infer H2O from space, an extensive validation program has been undertaken that incorporates correlative measurements and comparisons to other global data sets. This paper presents preliminary zonal means for November 1985 and compares them to tropospheric water vapor and the LIMS stratospheric water vapor. Correlative measurements from a frost-point hygrometer are also compared to individual SAGE II profiles. The quality and consistency of the SAGE II water vapor will lead to an improved understanding of the global water vapor climatology, aerosol formation mechanisms, and tropospheric/stratospheric exchange processes. (See also W91-00576) (Lantz-PTT)
W91-00579

MEASUREMENTS OF H2O IN THE TERRESTRIAL MESOSPHERE AND IMPLICATIONS FOR EXTRA-TERRESTRIAL SOURCES.
Pennsylvania State Univ., University Park. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W91-00580

NIMBUS 7 LIMS WATER VAPOR MEASUREMENTS.
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 2B.
W91-00581

EVALUATION OF AUTOMATED TECHNIQUES FOR BASE FLOW AND RECESSION ANALYSES.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W91-00593

AUTOMATED PRECONCENTRATION OF TRACE METALS FROM SEAWATER AND FRESHWATER.
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
A. van Geen, and E. Boyle.
Analytical Chemistry ANCHAM, Vol. 62, No. 15, p 1705-1709, August 1990. 3 fig, 4 tab, 10 ref. ONR Contract N00014-86-K-0325.

Descriptors: *Automation, *Chemical analysis, *Heavy metals, *Metal complexes, *Preconcentration, *Separation techniques, *Trace metals, *Water analysis, Adsorption, Freshwater, Ion exchange, Resins, Seawater.

A reliable method capable of processing a large number of samples was required for work on the distribution of trace metals in coastal waters. The separation and concentration of trace metals from sample matrices by solvent extraction is a labor-intensive procedure that is not easily automated. An alternative method is described based on the adsorption of complex metals onto a resin column. A previous version of this method was modified in key aspects to allow for analyses at typical natural dissolved metal concentrations (less than 0.01 mM). Sodium bis(2-hydroxyethyl) dithiocarbamate (NaHEDC) was shown to form water-soluble hydrophobic complexes with several metals (cadmium, cobalt, copper, nickel, lead and zinc). These complexes adsorbed quantitatively on XAD-4 resin when seawater or distilled water, spiked at concentrations on the order of 1 mM, was passed through a column. With this procedure, ten 30 ml samples can be preconcentrated with only 1 hour of operator attention; the complete procedure is completed in less than 4 hours. The nonautomated manipulations include preparations for a set of extractions and sample loading. The sample throughput rate (samples preconcentrated per hour) is not higher than could be achieved by an experienced worker using solvent extraction, but the analyst's productivity is much higher with the present method since other work can be done while preconcentration is underway. The device is constructed for the most part from commercially available components and could be adapted easily to other column separation techniques requiring trace metal-clean conditions. (VerNooy-PTT)
W91-00615

FLUORESCENT POLYCYCLIC AROMATIC HYDROCARBONS AS PROBES FOR STUDYING THE IMPACT OF COLLOIDS ON POLLUTANT TRANSPORT IN GROUNDWATER.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 5B.
W91-00623

PO210 AND PB210 REMOBILIZATION FROM LAKE SEDIMENTS IN RELATION TO IRON AND MANGANESE CYCLING.
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-00624

PALAEOFLOOD HYDROLOGY: A TOOL FOR SOUTH AFRICA--AN EXAMPLE FROM THE CROCODILE RIVER NEAR BRITS, TRANSVAAL, SOUTH AFRICA.
Geological Survey, Pretoria (South Africa). Regional Geology Div.
For primary bibliographic entry see Field 2E.
W91-00636

AUTOMATED DETERMINATION OF SILICA IN SURFACE AND GROUND WATER (DIE OUTOMATIESE BEPALING VAN SILIKA IN OPPERVLAK EN GRONDWATER).
Pretoria Univ. (South Africa). Dept. of Chemistry.
J. F. van Staden, J. J. Pauer, H. R. van Vliet, and P. L. Kempster.
Water SA WASADV, Vol. 16, No. 3, p 205-210, July 1990. 4 fig, 10 tab, 15 ref. English summary.

Descriptors: *Autoanalyzers, *Chemical analysis, *Colorimetry, *Measuring instruments, *Silica, *Water analysis, Automation, Dyes, Groundwater, Ions, Metal complexes, Surface water.

An automated flow-injection procedure for the determination of silica in surface and ground water was developed. The reduced heteropoly molybdenum blue-formed complex from molybdosilicic acid was used as the detection product at 660 nm. Ascorbic acid was used as reductant and oxalic acid was used to decompose the formed molybdophosphoric acid complex eliminating the interference of phosphate. Interferences of a number of ions, i.e., phosphate, fluoride, chloride, sulfate, nitrate, sodium, potassium, calcium and magnesium, were evaluated and the results given. The proposed method was evaluated in the range of 0.07 to 20 mg/cu dm Si. At a sample frequency of 90 samples per hour a good precision and accuracy were achieved and the carry-over between samples was less than 1%. (Author's abstract)
W91-00638

SYNCHRONOUS FLUORESCENCE SPECTROSCOPY OF DISSOLVED ORGANIC MATTER IN SURFACE WATERS: APPLICATION TO AIRBORNE REMOTE SENSING.
Cornell Univ., Ithaca, NY. Cornell Lab. for Environmental Applications of Remote Sensing.
For primary bibliographic entry see Field 5A.
W91-00639

STRIDES IN NONDESTRUCTIVE TESTING.
Olson Wright NDT and E, Inc., Lakewood, CO.
For primary bibliographic entry see Field 8G.
W91-00676

LITTORAL BENTHIC FAUNA OF LAKE MANAGUA, NICARAGUA: A STUDY COMPARING ARTIFICIAL AND NATURAL SUBSTRATA.
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
For primary bibliographic entry see Field 2H.
W91-00681

DETERMINATION OF THE ENVIRONMENTAL CAPACITY OF HAIFA BAY WITH RESPECT TO THE INPUT OF MERCURY.
National Inst. of Oceanography, Haifa (Israel).
For primary bibliographic entry see Field 5B.
W91-00706

TWO HYDRODYNAMICALLY STABLE SELF-SUSPENDED BUOYANT SEDIMENT TRAPS.
Stockholm Univ. (Sweden). Dept. of Zoology.
For primary bibliographic entry see Field 2J.
W91-00721

USE OF CHLOROFORM IN SEDIMENT TRAPS: CAUTION ADVISED.
Bergen Univ. (Norway). Dept. of Marine Biology.
K. Gundersen, and P. Wassmann.
Marine Ecology Progress Series MESEDT, Vol. 64, No. 1/2, p 187-195, June 28, 1990. 7 fig, 2 tab, 48 ref.

Descriptors: *Chloroform, *Experimental design, *Sample preservation, *Sampling, *Sediment sam-

pler, Chlorophyll a, Oceanography, Organic carbon, Organic matter, Performance evaluation, Zooplankton.

Experiments were conducted to study the effect of chloroform addition to sediment traps in the laboratory and in the field. Chloroform gave rise to extensive leaching of pigments and probably also other soluble organic compounds when fresh organic matter entered sediment traps. Droplets of chloroform suppressed microbial degradation of organic matter in the traps for few days, but did not stop it. The presence of chloroform resulted in anesthesia of 'swimmers' such as cladocerans and copepods and their subsequent death. Thus, chloroform led to accumulation and disintegration rather than exclusion or preservation of 'swimmers.' The field and laboratory experiments suggested that loss of organic matter in unpoisoned traps was due more to 'swimmers,' which entered, grazed, and left the trap than to microbial degradation per se. Chloroform does not increase significantly the accuracy of vertical flux data. On the contrary, it gives rise to significant undesirable side-effects, e.g., overestimation and underestimation of particulate organic carbon and chlorophyll a sedimentation rates, respectively. (Author's abstract)
W91-00731

LARGE-SCALE PATTERNS OF NODULARIA SPUMIGENA BLOOMS IN PYRAMID LAKE, NEVADA, DETERMINED FROM LANDSAT IMAGERY: 1972-1986.
Arizona State Univ., Tempe. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-00749

SPOT AND ENVIRONMENTAL STUDIES: AN ADVANCED SYSTEM TO COLLECT UP TO DATE GEOGRAPHIC INFORMATION.
SPOT Image Corp., Toulouse (France).
J. C. Rivereau, and M. Pousse.
Toxicological and Environmental Chemistry TXECBP, Vol. 27, No. 4, p 197-200, 1990.

Descriptors: *Data acquisition, *Mapping, *Remote sensing, *SPOT satellite, *Satellite technology, Civil engineering, Desertification, Groundwater pollution, Hydrography, Land degradation, Multiobjective planning, Repeat imaging, Stereoscopy, Urban planning, Water resources management.

SPOT 1, the first Earth observation satellite of the SPOT program, has been in orbit for more than three years and has currently gathered one million images of the Earth. SPOT is a technologically advanced system to gather geographic updated information and to monitor Earth surface phenomena. SPOT presents some unique features: 10 m and 20 m ground resolution, repeat imaging capability and stereoscopy associated with more conventional advantages of space remote sensing such as synoptic and global coverage. It is therefore an efficient tool to study and monitor a variety of environmental phenomena. Land use maps and inventories of natural, cultivated and urban areas are rapidly completed with SPOT data. In addition to current status assessment and monitoring, SPOT data are used to foresee and anticipate consequences of planned modification. Impact studies in civil engineering such as roads, railways, power lines, dams, and urban projects can be simulated in 3D perspective views and different scenarios investigated in a global context. The high revisit capability of SPOT allows monitoring of coastal evolution, shoreline modification, sediment transport, current studies, and siltation behavior of river water discharge. Land degradation and desertification problems are aided by SPOT analysis in ways such as hydrographic mapping; slope and exposure measurements; morphological, geological and soil mapping; and vegetal cover mapping. Fresh water availability and groundwater pollution concerns, such as catchment area protection; studies of erosion and siltation; and protection of groundwater recharge perimeters from waste in fracture zones; can all be aided by the accurate mapping of results is obtained with SPOT high precision imagery. The data extracted from analysis are easily introduced into Geographic Information Systems or any digital georeferenced data bank to be merged with other sources of information. (Brunone-PTT)
W91-00793

DEVELOPMENT OF A NEW METHODOLOGY FOR THE ASSESSMENT OF SPECIFIC METHANOGENIC ACTIVITY.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-00805

RESPIRATION INHIBITION KINETIC ANALYSIS.
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 5D.
W91-00810

MICROBIAL SENSOR FOR BOD.
Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Molekularbiologie.
For primary bibliographic entry see Field 5A.
W91-00812

USE OF A GEL-FORMING BIOPOLYMER DIRECTLY DISPENSED INTO A LOOP FLUIDIZED BED REACTOR TO RECOVER DISSOLVED COPPER.
California State Univ., Long Beach. Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W91-00813

ISOLATION OF DISSOLVED ORGANIC MATTER FROM THE SUWANNEE RIVER USING REVERSE OSMOSIS.
Georgia Inst. of Tech., Atlanta. School of Earth and Atmospheric Sciences.
For primary bibliographic entry see Field 5B.
W91-00816

DETECTION AND ANALYSIS OF TWO SEROTYPES OF AMMONIA-OXIDIZING BACTERIA IN SEWAGE PLANTS BY FLOW CYTOMETRY.
ORPEGEN, Medizinisch-Molekularbiologische Forschungsgesellschaft mbH, Heidelberg, Germany.
For primary bibliographic entry see Field 5D.
W91-00831

COMPARISON OF TWO CLOUDWATER/FOGWATER COLLECTORS: THE ROTATING ARM COLLECTOR AND THE CALTECH ACTIVE STRAND CLOUDWATER COLLECTOR.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
J. L. Collett, B. C. Daube, J. W. Munger, and M. R. Hoffmann.
Atmospheric Environment ATENBP, Vol. 24A, No. 7, p 1685-1692, July 1990. 5 fig, 1 tab, 23 ref. California Air Resources Board Contract A4-075-32.

Descriptors: *Cloud chemistry, *Cloud liquid water, *Fog, *Measuring instruments, *Precipitation gages, *Rain gages, *Sampling, *Water sampling, Calcium, California, Chemical analysis, Chlorides, Clouds, Comparison studies, Data acquisition, Fogwater, Liquid water content, Magnesium, Nitrates, Nitrites, Santa Barbara Channel, Sodium, Sulfates.

A side-by-side comparison of the Rotating Arm Collector (RAC) and the Caltech Active Strand Cloudwater Collector (CASCC) was conducted at an elevated coastal site near the eastern end of the Santa Barbara Channel in southern California. The CASCC was observed to collect cloud water at rates of up to 8.5 ml/min. Collection rates for the RAC as high as 2 ml/min have been observed in previous studies. The ratio of cloud water collection rates was found to be close to the theoretical prediction of 4.2:1 (CASCC:RAC) over a wide range of liquid water content (LWC). At low LWC, however, this ratio climbed rapidly, possibly reflecting a predominance of small droplets under these conditions, coupled with a greater collection efficiency of small droplets by the CASCC. Cloud water samples collected by the RAC had significantly higher concentrations of Na(+), Ca(2+), Mg(2+), and Cl(-) than those collected by the CASCC. These higher concentrations may be due to differences in the chemical composition of large versus small droplets. No significant differences were observed in concentrations of NO3(-), SO4(2-), or NH4(+) in samples collected by the two instruments. (Author's abstract)
W91-00844

RADIOMETRIC STUDIES OF CLEAR AIR ATTENUATION AND ATMOSPHERIC WATER VAPOR AT 22.235 GHZ OVER CALCUTTA (LAT. 22 DEGREES 32 MINUTES N, LONG. 88 DEGREES 20 MINUTES E).
Calcutta Univ. (India). Inst. of Radiophysics and Electronics.
For primary bibliographic entry see Field 2B.
W91-00852

FURTHER DISCUSSION ON THE INTERCOMPARISON OF THE TRACE METAL CONCENTRATIONS AND PARTICLE SIZE OF FLUVIAL SEDIMENT RECOVERED FROM TWO CENTRIFUGE SYSTEMS.
Geneva Univ. (Switzerland). Inst. F.-A. Forel.
For primary bibliographic entry see Field 5A.
W91-00866

TRANSPIRATION OF PLANTATION PINUS RADIATA ESTIMATED BY THE HEAT PULSE METHOD AND THE BOWEN RATIO.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 2D.
W91-00867

NOTE ON THE ANALYSIS OF MOISTURE-DEPTH CURVES OBTAINED BY THE HOT-AIR METHOD FOR THE DETERMINATION OF SOIL MOISTURE DIFFUSIVITY.
Botswana Univ., Gaborone. Dept. of Geology.
For primary bibliographic entry see Field 2G.
W91-00889

USING RN222 TO EXAMINE GROUNDWATER/SURFACE DISCHARGE INTERACTION IN THE RIO GRANDE DE MANATI, PUERTO RICO.
Florida Univ., Gainesville. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00893

EFFECT OF OBLIQUE RAIN ON INCLINED SURFACES: A NOMOGRAPH FOR THE RAIN-GAUGE CORRECTION FACTOR.
Agricultural Univ., Wageningen (Netherlands). Dept. of Hydraulics and Catchment Hydrology.
J. L. M. P. de Lima.
Journal of Hydrology JHYDA7, Vol. 115, No. 1/4, p 407-412, July 1990. 2 fig, 7 ref, append.

Descriptors: *Error analysis, *Nomographs, *Rain gages, *Rainfall, Correction factors, Mathematical analysis, Measuring instruments, Slopes, Wind.

Inclined rainfall leads to errors in the assessment of effective precipitation in areas with rugged relief. This affects many hydrological studies such as hydrologic forecasts, water erosion, determination of conditions for flash flood formation, determination of cropping conditions, etc. A nomograph is presented for the rain-gage correction factor (C-gau), by which rainfall measured in a standard horizontal rain-gage (P-gau) may be corrected to obtain the rainfall flux actually received on the inclined surface under study (P-act = C-gau x P-gau). The correction factor is assumed to be a

function of wind (with constant wind velocity), type of rainfall, and inclination and orientation of the sloping surface with respect to the oblique rain. Care should be taken in the use of the nomograph and in the interpretation of the results. In the construction of the nomograph, drop size and wind velocities are assumed constant in time and no allowance is made for the local turbulence created by the rain gage, or for its exposure. In addition, the effects of topography on local variations in rainfall may cause an error in the utilization of the nomograph. (Hoskin-PTT)
W91-00899

SAMPLING AND ANALYSIS OF HAZARDOUS WASTES.
Environmental Monitoring Systems Lab., Research Triangle Park, NC.
For primary bibliographic entry see Field 5A.
W91-00958

STUDY ON SHORT-TERM RAINFALL PREDICTION BY RADAR RAINGAUGE.
Public Works Research Inst., Tsukuba (Japan).
For primary bibliographic entry see Field 2B.
W91-00962

7C. Evaluation, Processing and Publication

MATHEMATICAL MODELLING OF THE EFFECT OF SIZE DISTRIBUTION ON SUSPENDED PARTICLES IN DEEP-BED FILTRATION.
Chia Nan Junior Coll. of Pharmacy, Tainan (Taiwan).
For primary bibliographic entry see Field 5F.
W91-00022

TIDES IN THE ENGLISH CHANNEL AND SOUTHERN NORTH SEA. A FREQUENCY DOMAIN ANALYSIS USING MODEL TEA-NL.
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 2L.
W91-00045

COMPARISON OF TWO FINITE ELEMENT MODELS OF TIDAL HYDRODYNAMICS USING A NORTH SEA DATA SET.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2L.
W91-00046

TIDAL FLOW SIMULATION IN THE ENGLISH CHANNEL AND SOUTHERN NORTH SEA.
Katholieke Univ. Leuven (Belgium). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W91-00047

SIMULATION OF THE TIDAL FLOW IN THE ENGLISH CHANNEL AND THE SOUTHERN NORTH SEA BY A CURVILINEAR FINITE DIFFERENCE MODEL.
Rijkswaterstaat, The Hague (Netherlands). Div. of Tidal Waters.
For primary bibliographic entry see Field 2L.
W91-00048

ONE-DIMENSIONAL MODEL FOR THE TRANSPORT OF A SEDIMENT MIXTURE IN NON-EQUILIBRIUM CONDITIONS.
Trento Univ. (Italy).
For primary bibliographic entry see Field 2J.
W91-00070

ESTIMATING STATISTICAL PARAMETERS FOR AN N-SEGMENT DISCRETE HYDROLOGIC DATA SERIES.
Clark Univ., Worcester, MA. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W91-00074

GROUNDWATER MODELLING AS A TOOL FOR WATER MANAGEMENT: WAIMEA PLAINS, NELSON.
Nelson Catchment Board (New Zealand).
For primary bibliographic entry see Field 2F.
W91-00075

VARIABLE LAPSE RATE SNOWLINE MODEL FOR THE REMARKABLES, CENTRAL OTAGO, NEW ZEALAND.
Department of Scientific and Industrial Research, Christchurch (New Zealand). Land and Soil Science Div.
For primary bibliographic entry see Field 2C.
W91-00076

HYDROCLIMATIC APPLICATION STRATEGY FOR THE POISSON PARTIAL DURATION MODEL.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00084

ERRORS IN ESTIMATED STREAMFLOW PARAMETERS AND STORAGES FOR UNGAUGED CATCHMENTS.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W91-00085

DEVELOPMENT OF A WATER AND WASTEWATER SCADA SYSTEM.
Wiley and Wilson, Inc., Lynchburg, VA.
For primary bibliographic entry see Field 5F.
W91-00101

COMPUTER-OPERATED TREATMENT PLANT PROVIDES TOP QUALITY WATER.
Bogert (Clinton) Associates, Fort Lee, NJ.
For primary bibliographic entry see Field 5F.
W91-00106

SPATIAL AND TEMPORAL VARIABILITY OF PRECIPITATION ACROSS KENTUCKY.
Louisville Univ., KY. Dept. of Geography.
For primary bibliographic entry see Field 2B.
W91-00110

PCG SOLUTIONS OF FLOW PROBLEMS IN RANDOM POROUS MEDIA USING MIXED FINITE ELEMENTS.
California Univ., Irvine. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-00117

MODELING INFILTRATION IN HYSTERETIC SOILS.
Kentucky Univ., Lexington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W91-00118

NUMERICAL MODEL FOR AREAL MIGRATION OF WATER AND LIGHT HYDROCARBON IN UNCONFINED AQUIFERS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 5B.
W91-00120

PROPAGATION OF PERIODIC WAVES IN THE LIDO CHANNEL OF THE VENICE LAGOON.
For primary bibliographic entry see Field 2L.
W91-00121

VARIATIONAL PRINCIPLE METHOD WITH VARIABLE DOMAIN IN THE FLOW PROBLEM WITH FREE SURFACE.
Shanghai Inst. of Mechanical Engineering (China).
For primary bibliographic entry see Field 8B.
W91-00122

TIME SERIES ANALYSIS OF UNEQUALLY SPACED OBSERVATIONS-WITH APPLICATIONS TO COPPER CONTAMINATION OF THE RIVER GAULA IN CENTRAL NORWAY.
Norsk Regnesentral, Oslo.
For primary bibliographic entry see Field 5B.
W91-00128

STATISTICS-BASED SYSTEM FOR TREATMENT PLANT OPERATION.
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W91-00129

STATE ESTIMATION IN WASTEWATER ENGINEERING: APPLICATION TO AN ANAEROBIC PROCESS.
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
For primary bibliographic entry see Field 5D.
W91-00130

SOME COMMENTS ON ANALYSIS TECHNIQUES FOR CENSORED WATER QUALITY DATA.
Waterloo Univ. (Ontario). Dept. of Health Studies.
For primary bibliographic entry see Field 5G.
W91-00131

ESTIMATION OF PHOSPHORUS FROM THE NIAGARA RIVER TO LAKE ONTARIO.
Waterloo Univ. (Ontario).
For primary bibliographic entry see Field 5E.
W91-00133

INFERENCES ABOUT POINT SOURCE LOADING FROM UPSTREAM/DOWNSTREAM RIVER MONITORING DATA.
International Joint Commission-United States and Canada, Windsor (Ontario).
For primary bibliographic entry see Field 5B.
W91-00135

MEASURES OF FLOW VARIABILITY FOR GREAT LAKES TRIBUTARIES.
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
For primary bibliographic entry see Field 2E.
W91-00136

ROBUST GRAPHICAL METHODS FOR DIAGNOSING TREND IN IRREGULARLY SPACED WATER QUALITY TIME SERIES.
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
For primary bibliographic entry see Field 5B.
W91-00138

DEVELOPMENT OF A SOFTWARE PACKAGE FOR TREND DETECTION IN TEMPORAL SERIES: APPLICATION TO WATER AND INDUSTRIAL EFFLUENT QUALITY DATA FOR THE ST. LAWRENCE RIVER.
INRS-Eau, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W91-00139

ONE-DIMENSIONAL INTERACTIVE SOIL-ATMOSPHERE MODEL FOR TESTING FORMULATIONS OF SURFACE HYDROLOGY.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2A.
W91-00145

STABILITY LIMITS FOR PREISSMANN'S SCHEME.
Hydraulics Research Ltd., Wallingford (England).
For primary bibliographic entry see Field 2E.
W91-00150

NONPARAMETRIC FLOOD-FREQUENCY ANALYSIS WITH HISTORICAL INFORMATION.
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00152

SIMULATION OF DISPERSION IN LAYERED COASTAL AQUIFER SYSTEMS.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00155

RAINFALL INTERCEPTION IN THE TAI FOREST, IVORY COAST: APPLICATION OF TWO SIMULATION MODELS TO A HUMID TROPICAL SYSTEM.
Groningen Rijksuniversiteit (Netherlands). Dept. of Physical Geography.
For primary bibliographic entry see Field 2B.
W91-00158

SOME FUNDAMENTAL WEAK SPOTS OF KRIGING TECHNIQUE AND THEIR CONSEQUENCES.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Soil and Groundwater.
J. W. De Kwaadsteniet.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 277-284, May 1990. 1 fig, 8 ref.

Descriptors: *Data interpretation, *Kriging, *Mapping, *Monitoring wells, *Observation wells, *Statistical methods, Analysis of variance, Geostatistics, Noise, Optimization, Spatial distribution.

The spatial interpolation technique known as 'kriging' has become a significant technique in the Earth sciences, making up the bulk of what is called 'geostatistics.' The kriging technique is also applied in groundwater hydrology. This technique is not only used for interpolation but for optimization purposes as well. Kriging owes much of its popularity to its combination of properties: (1) each estimate is supplied with confidence information; (2) an estimated spatial picture of a variable links up continuously with the observations at the observation points; and (3) the technique is mathematically elegant and can easily be programmed. However, insufficient attention has been paid to a number of fundamental weak spots of the kriging technique, in spite of their serious practical consequences. At the basis of kriging, the spatial variable studied is split into a deterministic part and a noise part while in the usual context (one observed realization at each observation point) such a division is impossible without making assumptions unconnected with the data considered. As a consequence, kriging results are highly artificial in the usual context. The artificiality can be removed if several realizations from each observation point are available, as for example, in the case of a monitoring network of groundwater head, since a specification of the noise part can be given, particularly of its variance/covariance structure. First results point to a large inhomogeneity of variance and a large autocorrelation in groundwater head on a regional scale. Some attention must be paid to the consequences of these specific properties, also with regard to the optimization of monitoring networks. (Author's abstract)
W91-00159

ESTIMATING GROUNDWATER RECHARGE USING A SURFACE WATERSHED MODEL: SENSITIVITY ANALYSES.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
F. H. S. Chiew, and T. A. McMahon.
Journal of Hydrology JHYDA7, Vol. 114, No. 3/4, p 305-325, May 1990. 14 fig, 2 tab, 9 ref, append.

Descriptors: *Groundwater recharge, *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *Sensitivity analysis, *Surface-groundwater relations, Australia, Groundwater management, Model testing, Parametric hydrology, Simulation analysis, Streamflow data, Watersheds.

A surface watershed modeling approach was used to obtain groundwater recharge as an output from the rainfall-runoff process model HYDROLOG by calibrating HYDROLOG against streamflow records. The parameters in HYDROLOG were fitted to minimize a streamflow objective function. The model can thus provide accurate recharge estimates only if the parameters to which the recharge estimates are sensitive are also those to which the streamflow objective function is sensitive, otherwise recharge estimates will remain unchanged as the parameters which influence the streamflow objective function are progressively altered to reduce the value of the objective function. Analyses were carried out in a catchment area in northern Victoria, Australia, to guide further improvements in the model and to investigate the sensitivity of the objective function and the recharge estimates to the parameters in HYDROLOG, using NLFIT (an optimization package) and sensitivity plots. The analyses indicated that this approach was promising. The streamflow objective function was sensitive to the parameters in the model which influenced the recharge estimates, thus calibrating the model against streamflow records appears to be a reasonable way to obtain the parameters influencing recharge. The sensitivity analyses also indicated that the objective function and the recharge estimates were not sensitive to some parameters and some parameters were strongly correlated to another parameter. Only a few simulation runs were required to obtain appropriate estimates for the less important parameters, reducing the number of parameters to be optimized during the subsequent simulation runs. (See also W91-00160) (Fish-PTT)
W91-00161

EVALUATION OF THREE EVAPOTRANSPIRATION MODELS IN TERMS OF THEIR APPLICABILITY FOR AN ARID REGION.
Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.
For primary bibliographic entry see Field 2D.
W91-00165

DRIP IRRIGATION NONLINEAR OPTIMIZATION MODEL.
Concepcion Univ. (Chile). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W91-00168

2-D BED EVOLUTION IN NATURAL WATERCOURSES: NEW SIMULATION APPROACH.
Energoprojekt, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 2J.
W91-00177

REGIONAL FLOW-DURATION CURVES FOR UNGAUGED SITES IN MASSACHUSETTS.
Massachusetts Div. of Water Supply, Boston.
For primary bibliographic entry see Field 2E.
W91-00185

OPTIMIZATION OF FRESHWATER INFLOW TO ESTUARIES.
Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 2L.
W91-00187

PUMPING TEST IN A LOW PERMEABILITY CLAYSTONE AQUIFER EXECUTED WITH HIGH-RESOLUTION ELECTRONIC WATER LEVEL RECORDERS AND EVALUATED WITH THE VERSATILE COMPUTER PROGRAM HYDROPAR.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
For primary bibliographic entry see Field 2F.
W91-00216

ANALYSIS OF PUMPING TEST DATA FROM BOREWELLS IN FRACTURED ROCKS OF KARNATAKA.
Roorkee Univ. (India). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W91-00217

ANALYSIS OF TEST PUMPING DATA FROM UNCONFINED AQUIFERS BY SIMULATION.
Roorkee Univ. (India). School of Hydrology.
For primary bibliographic entry see Field 2F.
W91-00218

CRITICAL EVALUATION OF PUMPING TEST DATA FROM FRACTURED CRYSTALLINE FORMATION.
Madras Univ. (India). Dept. of Applied Geology.
For primary bibliographic entry see Field 2F.
W91-00219

COMPUTATION OF TRANSMISSIVITY FROM STEP-DRAWDOWN TESTS.
Action for Food Production (AFPRO), Geohydrological Investigation Team, Hyderabad-500 007.
For primary bibliographic entry see Field 2F.
W91-00220

JOINT SYSTEM ANALYSIS FOR THE EVALUATION OF FLOW IN FRACTURED AQUIFER.
Central Ground Water Board, Bhubaneswar (India).
P. K. Das, and S. B. Mallik.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 131-141, 6 fig, 1 tab, 8 ref.

Descriptors: *Data interpretation, *Geohydrology, *Geologic fractures, *Geology, *Groundwater movement, *Joint systems analysis, Aquifers, Developing countries, Graphical analysis, Groundwater budget, Groundwater level, India, Kasai River, Maps, Permeability, Resistivity.

An intensive study has been made of Joint System of Precambrian Crystalline rocks occurring at the township of Khatra in Bankura District, West Bengal. The area is mantled by saprolite derived from weathering of phyllites, micaschist, granite, amphibolites and quartzites. The saprolite aquifer is considered to be isotropic in nature which may be evidence from the water table contour maps which were prepared from close observation of the wells. The saturated fractured rocks occurring just below the saprolite aquifer can be determined from electrical resistivity studies and borehole data. Analysis of the joint system of this aquifer can be made from the exposed rocks. The predominant joint sets have been determined by graphical techniques from the central tendencies of all the joint planes giving rise to a characteristic joint geometry of different sectors in the area. Study of different sets of dispersion shows that the medium is largely anisotropic and that the principle permeability direction of joint sets is contained in the southeastern direction. It can be shown that the course of streams and creeks appear to bear some relation to the major permeability direction, and that the base flow of the Kasai River is maintained by the fractured aquifer. (See also W91-00215) (Lantz-PTT)
W91-00228

APPROACH IN DETERMINATION OF AQUIFER GEOMETRY AND ESTIMATION OF AQUIFER PARAMETERS OF AN AREALLY EXTENSIVE UPPER KAMTHI SANDSTONE AQ-

UIFER IN PARTS OF GODAVARI VALLEY, ANDHRA PRADESH.
For primary bibliographic entry see Field 2F.
W91-00231

AQUIFER PARAMETER ESTIMATION AND GROUNDWATER POTENTIALITY IN GRANITE-BASALT TERRAIN NEAR HYDERABAD, INDIA.
Osmania Univ., Hyderabad (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00233

PARAMETER ESTIMATION FOR A QUASI-THREE-DIMENSIONAL FLOW MODEL.
Asian Inst. of Tech., Bangkok (Thailand).
A. Das Gupta, and A. S. Srikanthan Herath.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 197-208, 6 fig, 2 tab, 7 ref.

Descriptors: *Data interpretation, *Groundwater movement, *Mathematical models, *Model studies, Hydrologic models, Mathematical equations, Mathematical studies, Piezometric head, Sensitivity analysis.

Parameter estimation for 3-dimensional groundwater flow is based on the sensitivity of the analysis approach. Flow models consist of a two dimensional partial differential equations representing flow in individual layers and vertical leakage terms coupling the layers with transmissivities, storativities and leakage factors as unknown parameters of the model. An alternative, direction implicit method is used to solve the equation numerically with specified initial and boundary conditions. The parameters are identified by improving on a set of initial parameters using the square of the difference between the observed and computed piezometric head values. Initially the model responses were evaluated by applying the algorithm for a hypothetical two-layer aquifer system. The possibility of application to a multi-layer aquifer system underlying the city of Bangkok was then investigated. Sensitivity analysis could be used to identify a set of parameters in a hydrologic model. However, the main drawback with this method is the extensive computation time involved. (See also W91-00215) (Lantz-PTT)
W91-00236

KRIGED ESTIMATES OF WATER-LEVELS FROM THE SPARSE MEASUREMENTS IN A HARD ROCK AQUIFER.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W91-00245

FRACTURE PATTERN MODELLING FOR GROUNDWATER TARGETTING IN HARD ROCK TERRAIN: A STUDY AIDED BY REMOTE SENSING TECHNIQUE.
Indian Inst. of Tech., Madras.
K. Usha, S. M. Ramasamy, and S. P. Subramanian.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 319-328, 6 fig, 2 ref.

Descriptors: *Data interpretation, *Geohydrology, *Groundwater resources, *Model studies, *Remote sensing, Data acquisition, Digital map data, Geologic fractures, Groundwater level, Groundwater movement, Heterogeneity, Maps.

The groundwater conditions in hard rock terrain are multivariate due to the heterogeneous nature of the aquifer. This is due to the varying composition, compaction, density of fracturing and degree of weathering. As a result, targeting of groundwater in such terrain has proven to be complex. In the present model, the lithologic and deformational fabrics have been brought out in detail using digital enhancement and enlarged formats of the Thematic Mapper Data. From these surface signatures, subsurface configuration of the folded structure, and the nature and morphology of the fractured system have been analyzed. Various fracture density diagrams were drawn and the information integrated with water level and water table maps. Thus, the exact controls of groundwater mobility and stability have been identified. Analysis of structural trends and water level contour diagrams suggest that the synclinal areas have more potential for groundwater targeted in hard-rock terrain. (See also W91-00215) (Lantz-PTT)
W91-00250

DIGITAL ENHANCEMENT OF SURFACE GEOLOGIC FEATURES IN A PART OF BANAS RIVER CATCHMENT FOR GROUND WATER POTENTIAL CHARACTERIZATION.
Central Ground Water Board, Jaipur (India).
O. N. Tiwari.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 333-336, 1 fig, 6 ref.

Descriptors: *Data interpretation, *Digital map data, *Groundwater resources, *Remote sensing, *Well yield, Geomorphology, Groundwater budget, India, Landsat, Mount Abu, Satellite technology.

For two decades, machine processing techniques for remotely sensed data have steadily advanced. Pattern recognition and enhancement techniques are application oriented operations. Digital enhancement of images and their interpretation has established itself as significant for lithological, structural, and geomorphological studies. These criteria are necessary for establishing evidence for the presence of groundwater potential. An attempt to assess groundwater availability in the semi-arid catchment area of Mt. Abu is made. Materials and methods that were employed included Landsat MSS data interpreted along with Indian Remote Sensing Satellite (IRS) simulated imagery; a sub-image of Landsat MSS bands 4,5,6, and 7, and separate maps on lithology, lineament, drainage, and geomorphology. This study has highlights a linear contrast stretched image containing better geological details that can be integrated to define areas in terms of their potential for groundwater. Potential areas demarcated can be taken as sites for further geophysical and groundwater drilling operations. (See also W91-00215) (Lantz-PTT)
W91-00252

REMOTE SENSING BASED APPROPRIATE METHODOLOGY FOR THE GROUNDWATER EXPLORATION: A CASE STUDY FROM PRECAMBRIANS OF SOUTH INDIA.
Anna Univ., Madras (India). Inst. of Remote Sensing.
S. M. Ramasamy, S. T. Govindarajan, and T. Balasubramanian.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 341-344, 1 fig, 2 ref.

Descriptors: *Data acquisition, *Data interpretation, *Geohydrology, *Groundwater resources, Case studies, Groundwater level, Groundwater management, India, Paleohydrology.

A unique method is demonstrated for integrating groundwater resource information obtained from remotely sensed and proximally sensed/ground collected data. From the raw and digitally enhanced thematic mapper data lithological spectrum, deformational display of rocks and lineament fabric were extracted and these data were integrated by a multivariate analysis with water level, yield and transmissivity data and zones of groundwater mobility and stability were identified. The structural trends of such lithologies were interpreted on the basis of relief, drainage, soil tone and vegetation linearities/curvilinearities from the satellite imagery and total framework of such folds were brought out. The fracture controlled lineaments were interpreted on the basis of the same photo tone characters from the satellite data and such lineaments show a regional polymodel orientation. Water level fluctuations for a period of three years for over 2500 observation wells were standardized, values were plotted in their respective geographical positions, contoured, and from their contour linearity, groundwater level linearity was structured out. The integration of folded structures with groundwater level and yield shows that the water level linearity maxima faithfully follows the axis of the folds in Tirrunelveli, Madurrai, Pudukkottai and Ootacamund massif. The circular pattern of water level maxima northeast of Coimbatore shows the existence of a basin structure, a complimentary to Sankaridurg dome which holds the groundwater. Similarly, the yield maxima exhibits striking linearity and curvilinearity with axis of the first generation folds too which got refolded to NNW-SSE trending axial trace, whereas the transmissivity value maxima does not show any relation with folded structures. (See also W91-00215) (Lantz-PTT)
W91-00254

MOISTURE VARIATION STUDY BY NEUTRON-NEUTRON LOGGING.
Central Ground Water Board, Ahmedabad (India).
I. R. Bavaji.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 347-358, 6 fig, 4 tab, 4 ref.

Descriptors: *Borehole geophysics, *Data acquisition, *Data interpretation, *Groundwater resources, *India, *Neutron logging, *Neutron-neutron logging, *Soil water, Aeration zone, Boreholes, Ghanghar River Basin, Groundwater level, Logging (Recording), Water table.

Groundwater scientists are using the same borehole logging instruments that were initially designed for oil exploration purposes with little modification for groundwater studies. An attempt to solve one of the problems related to groundwater with neutron-neutron logging tools is addressed, with regard to locating soil moisture. Soil moisture is commonly regarded as the subsurface water in the zone of aeration. The zone of aeration is a zone of transition in which water is absorbed, held or transmitted either down toward the water table or up toward the soil surface and atmosphere. The neutron-neutron logging tool is one of the most useful tools available for porosity measurements of oil bearing formations, and was used to study the zones above the water table. The study of neutron-neutron logs recorded in 4-in. diameter wells in the Ghaghar River Basin reveals that the technique is very useful. On the basis of several case studies, it was concluded that a continuous volumetric record of moisture content is possible using neutron-neutron logging. The method also permits a repeated record without disturbing the formation and natural conditions. The depth-wise periodic variation in moisture content can be obtained using neutron-neutron logging. (See also W91-00215) (Lantz-PTT)
W91-00255

FUNCTIONAL RELATION FOR CAPILLARY SUCTION VS. MOISTURE CONTENT.
Roorkee Univ. (India). School of Hydrology.
K. M. Mohan Rao, D. Kashyap, and S. Chandra.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 405-409, 2 fig, 8 Ref.

Descriptors: *Capillary water, *Mathematical equations, *Soil water, *Soil water suction, Mathe-

matical models, Mathematical studies, Richards equation.

The Richard equation can be used to define a functional relationship between capillary suction and moisture, and to mathematically model flow in the unsaturated zone. A recommendation to adopt refined experimental data with an efficient numerical algorithm for differentiation and interpolation is made. In order to assist with the needs of elaborate experimental facilities, the proposed relationship between the Richards equation and capillary suction versus moisture content should be adopted. The Richard equation proved satisfactory when used for a field simulation problem. (See also W91-00215) (Lantz-PTT)
W91-00260

COMPUTER SIMULATION OF AN INJECTED TRACER MOVEMENT.
Central Water and Power Research Station, Poona (India).
For primary bibliographic entry see Field 2F.
W91-00262

INTERACTIVE GROUNDWATER DATABASE SYSTEM.
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
A. K. Dikshit, and S. Ramaseshan.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 443-456, 6 fig, 8 tab, 8 ref.

Descriptors: *Data storage and retrieval, *Databases, *Groundwater management, *Groundwater resources, *Hydrologic data collections, Computer programs, Computers, Data interpretation, Data processing, Water resources management.

Site specific water resources data, including design, development and operation of water resources systems are needed. To illustrate the development of a database and the use of Data Base Management Systems (DBMS), a groundwater database management system was developed for a part of Uttar Pradesh, India, using dBASE III PLUS language and data from the Central Groundwater Board for one year and U.P. Groundwater Investigation Organization for one decade for IBM-PC/XT. A multifile structure with a masterfile and other subsidiary files , each including a common field in order to establish a relationship between different databases has been used. A menu based interactive program using dBASE III PLUS has been developed to edit, update, sort and manipulate different databases and retrieve data as required. Since the DBMS languages provide for report generation, graphics and export of data to other systems, it is possible to generate formatted reports, results of statistical and numerical analyses, charts and maps from DBMS, and finally a menu-based interactive program will facilitate easy and efficient database management. (See also W91-00215) (Lantz-PTT)
W91-00263

TECHNIQUES OF AQUIFER PARAMETER EVALUATION USING POCKET COMPUTERS.
V.O.C. Coll., Tuticorin (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00265

ACQUISITION OF HYDROGEOLOGIC DATA FOR THE MAPPING OF SHALLOW UNCONFINED DECCAN BASALTIC AQUIFERS FROM MAHARASHTRA, INDIA.
Poona Univ. (India). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W91-00266

HYSTERESIS AND NONLINEARITY OF DISCHARGE-SEDIMENT RELATIONSHIPS IN THE ATCHAFALAYA AND LOWER MISSISSIPPI RIVERS.
Louisiana Geological Survey, Baton Rouge. Coastal Geology Section.
For primary bibliographic entry see Field 2J.
W91-00292

DEVELOPING ACCURATE AND RELIABLE SEDIMENT YIELDS.
Illinois State Water Survey Div., Champaign.
K. P. Singh, and A. Durgunoglu.
IN: Sediment and the Environment. Proceedings of a Symposium held in Baltimore, Maryland. IAHS Publication No. 184. International Association of Hydrological Sciences, Washington, DC. 1989. p 193-199, 4 fig, 1 tab, 8 ref.

Descriptors: *Data interpretation, *Mathematical models, *Model studies, *River sediments, *Sediment load, *Sediment yield, Analytical methods, Errors, Flow rates, Hydrographs, Regression analysis, River flow, Sampling, Seasonal variation, Sediment concentration, Sedimentation rates, Streamflow.

Quantitative estimates of stream sediment yields have usually been made by using empirical relations, most commonly the power function, which leads to considerable underestimation of annual sediment yields. The bias in the estimation of sediment loads by rating curve due to log-transformed estimates can be significantly reduced by using nonlinear regression. Further improvements can be achieved by identifying seasonalities and breaks in slopes of rating curves. Finally, the underestimation caused by using average daily flows with the rating curve can be eliminated by using sub-daily flow data, if available. The remaining problem that concerns both the log-transformed and the nonlinear regression methods is that a very limited number of sediment observations are made during high flows. Considering that 80-90% of the sediment load is carried during 10-15% of the flows, it is essential that more sediment samples be collected at high flows. (See also W91-00280) (MacKeen-PTT)
W91-00301

MODELLING AGRICULTURAL RUNOFF: OVERVIEW.
National Water Research Inst., Burlington (Ontario). Rivers Research Branch.
For primary bibliographic entry see Field 5B.
W91-00302

SOURCES OF HYDROLOGIC DATA ON MESOZOIC FORMATIONS IN THE UPPER COLORADO RIVER BASIN AND COMPARISON OF DATA ANALYSIS METHODS.
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00309

GEOPHYSICALLY DETERMINED POROSITY OF PALEOZOIC ROCKS IN THE UPPER COLORADO RIVER BASIN.
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00314

USING A GEOGRAPHIC INFORMATION SYSTEM TO DEVELOP A GROUND-WATER FLOW MODEL.
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00316

ESTIMATES OF EVAPOTRANSPIRATION IN ALKALINE SCRUB AND MEADOW COMMUNITIES OF OWENS VALLEY, CALIFORNIA, USING THE BOWEN-RATIO, EDDY-CORRELATION, AND PENMAN-COMBINATION METHODS.
Geological Survey, Washington, DC.
For primary bibliographic entry see Field 2D.
W91-00333

SELECTED QUALITY ASSURANCE DATA FOR WATER SAMPLES COLLECTED BY THE U.S. GEOLOGICAL SURVEY, IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO, 1980 TO 1988.
Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 7B.
W91-00334

HYDROGEOLOGY AND SIMULATION OF GROUND-WATER FLOW AT SUPERFUND-SITE WELLS G AND H, WOBURN, MASSACHUSETTS.
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00340

WATER RESOURCES DATA COLLECTED DURING WATER YEAR 1988 AT SELECTED JAMES RIVER BASIN SITES IN NORTH DAKOTA AND SOUTH DAKOTA.
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 6G.
W91-00342

SIGNIFICANCE OF SEDIMENT TRANSPORT IN ARROYO DEVELOPMENT.
Geological Survey, Vancouver, WA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W91-00346

GEOHYDROLOGY AND SIMULATED EFFECTS OF PUMPAGE ON THE NEW ORLEANS AQUIFER SYSTEM AT NEW ORLEANS, LOUISIANA.
Geological Survey, Baton Rouge, LA.
For primary bibliographic entry see Field 2F.
W91-00348

STATISTICAL PROCESSOR FOR ANALYZING SIMULATIONS MADE USING THE MODULAR FINITE-DIFFERENCE GROUND-WATER FLOW MODEL.
Geological Survey, Oklahoma City, OK.
J. C. Scott.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Water-Resources Investigations Report 89-4159, 1990. 218p, 9 fig, 10 tab, 16 ref.

Descriptors: *Computer programs, *Finite difference methods, *Flow models, *Groundwater movement, *Mathematical models, *Model studies, *Simulation analysis, Hydrologic data, Hydrologic models, Statistical analysis.

Many hydrologic studies of groundwater systems are conducted using a digital computer model as an aid to understanding the flow system. One of the most commonly used groundwater modeling programs is the Modular Three-Dimensional Finite-Difference Groundwater Flow Model (Modular Model). A computer program which summarizes the data input to and output from the Modular Model is presented. The program is named the Modular Model Statistical Processor and is designed to be run following the Modular Model. The Modular Model Statistical Processor provides groundwater modelers with the capabilities to easily read data input to and output from the Modular Model, calculate descriptive statistics, generate histograms, perform logical tests using relational operators, calculate data arrays using arithmetic operators, and calculate flow vectors for use in a graphical-display program. (Author's abstract)
W91-00353

ANALYSIS OF GEOPHYSICAL WELL LOGS AND FLOWMETER MEASUREMENTS IN BOREHOLES PENETRATING SUBHORIZON-

TAL FRACTURE ZONES, LAC DU BONNET BATHOLITH, MANITOBA, CANADA.
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 2F.
W91-00354

SOLINPUT: A COMPUTER CODE TO CREATE AND MODIFY INPUT FILES FOR THE GEOCHEMICAL PROGRAM SOLMINEQ.88.
Geological Survey, Menlo Park, CA.
J. D. DeBraal, and Y. K. Kharaka.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 89-616, 1989. 140p, 11 fig, 8 tab, 4 append.

Descriptors: *Computer models, *Computer programs, *Documentation, *Geochemistry, *Model studies, Digital computers, Error analysis, Parameterization.

SOLINPUT, an interactive computer program designed to create and modify input files for the geochemical code SOLMINEQ.88, is documented. The construction of input files is detailed and the computing environment needed to execute both programs is specified. The reactions, equations, and actual coding required to add aqueous and mineral components to both SOLMINEQ.88 and SOLINPUT are also outlined. Input files for SOLMINEQ.88 are created and edited by SOLINPUT using a menu-driven format. SOLINPUT is made up of a Main Menu, an Options Menu, and seven sub-menus. The Main Menu is concerned with reading and writing the input file, which may consist of up to 10 data sets, and is the only point from which SOLINPUT can be exited. The Options Menu directs the user to the appropriate submenu through which the basic physical and chemical data are entered and the modeling options are chosen. The items within each menu are arranged from top to bottom in the order in which they will be accessed. The last choice of each menu exits that menu and returns to the previous menu. SOLINPUT describes all the chemical and physical parameters required for each run of SOLMINEQ.88 as well as the parameters needed for user selected options. SOLINPUT allows numeric data to be entered using several convenient formats. It also performs error checking on input entered and prompts the user to correct invalid entries. (Author's abstract)
W91-00359

GRAPHICAL KERNEL SYSTEM (GKS) VERSION OF COMPUTER PROGRAM MODPATH-PLOT FOR DISPLAYING PATH LINES GENERATED FROM THE U.S. GEOLOGICAL SURVEY THREE-DIMENSIONAL GROUND-WATER FLOW MODEL.
Geological Survey, Reston, VA.
D. W. Pollock.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. Open-File Report 89-622, 1990. 49p, 7 ref, append.

Descriptors: *Computer models, *Computer programs, *Flow models, *Groundwater movement, *Mathematical models, *Model studies, Graphical analysis, Hydrologic models.

The computer program MODPATH-PLOT graphically displays results generated by the three-dimensional particle tracking program MODPATH. A new version of the computer program MODPATH-PLOT has been developed that uses the Graphical Kernel System (GKS) to generate graphical output. The Graphical Kernel System is a set of standardized graphics functions adopted by the American National Standards Institute (ANSI). GKS functions are widely available and can be obtained from many sources. The use of GKS in MODPATH-PLOT improves the program's portability between computers and makes the program accessible to a much broader cross section of groundwater hydrologists. (Author's abstract)
W91-00361

BIAS AND VARIANCE OF SOME ESTIMATORS OF SUSPENDED SEDIMENT LOAD.
Instituto de Pesquisas Hidraulicas, Porto Alegre (Brazil).
For primary bibliographic entry see Field 2J.
W91-00406

COUPLED SIMULATION OF TRANSIENT BED EVOLUTION IN ALLUVIAL CHANNELS.
National Chiao Tung Univ., Hsinchu (Taiwan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W91-00407

DYNAMIC MODEL FOR SHORT-SCALE RAINFALL DISAGGREGATION.
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W91-00409

COMPARATIVE STUDY OF MATHEMATICAL MODELS FOR THE RELATIONSHIP BETWEEN WATER TEMPERATURE AND BROOD DEVELOPMENT TIME OF GAMMARUS FOSSARUM AND G. ROESELI (CRUSTACEA: AMPHIPODA).
Vienna Univ. (Austria). Limnologische Lehrkanzel.
For primary bibliographic entry see Field 2H.
W91-00420

SIMPLIFIED METHODS OF ESTIMATING DAILY MEAN STREAM WATER TEMPERATURE.
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2E.
W91-00421

GROUND-WATER DATA FOR GEORGIA, 1988.
Geological Survey, Doraville, GA.
For primary bibliographic entry see Field 2F.
W91-00432

HYDROGEOLOGY AND WATER QUALITY OF SIGNIFICANT SAND AND GRAVEL AQUIFERS IN PARTS OF AROOSTOOK COUNTY, MAINE: SIGNIFICANT SAND AND GRAVEL AQUIFER MAPS 75, 76, 77, 78, 84, AND 85.
Maine Dept. of Environmental Protection, Augusta.
For primary bibliographic entry see Field 2F.
W91-00435

HYDROGEOLOGIC AND WATER-QUALITY DATA FROM WELL CLUSTERS NEAR THE WASTEWATER-TREATMENT PLANT, U.S. MARINE CORPS AIR STATION, CHERRY POINT, NORTH CAROLINA.
Geological Survey, Raleigh, NC.
For primary bibliographic entry see Field 5B.
W91-00438

NATIONAL WATER INFORMATION SYSTEM USER'S MANUAL VOLUME 2, CHAPTER 3, AUTOMATED DATA PROCESSING SYSTEM.
Geological Survey, Reston, VA.
Available from the US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225-0425. USGS Open-File Report 90-116. 341p, 7 fig, 6 tab. Compiled by George R. Dempster.

Descriptors: *Data storage and retrieval, *Databases, *Documentation, *Information systems, *National Water Information System, *Surface water, Computer programs, Data acquisition, Data processing, Groundwater data, Water quality.

The Automated Data Processing System (ADAPS) was developed for the processing, storage, and retrieval of water data, and is part of the National Water Information System developed by the U.S. Geological Survey. The National Water Information System is a distributed water data base in which data can be processes over a network of minicomputers at U.S. Geological Survey offices throughout the United States. This system comprises the Automated DAta Processing System, the Ground-Water Site Inventory System, the Quality of Water System, and the Water-Use Data System. This chapter of the National Water Information System User's Manual describes the automated data processing of continuously recorded water data, which are primarily surface-water data. However, the system allows for processing water quality and groundwater data. The manual introduces and describes various components and features of ADAPS, and provides an overview of the data-processing system and a description of the system framework. The components and features included are: (1) data collection and processing; (2) system programs and menus; (3) main menu task selections; (4) interaction with the mainframe computer at U.S. Geological Survey headquarters in Reston, Virginia; (5) control and transfer file descriptions created by ADAPS; and (6) steps for processing station records. (Author's abstract)
W91-00442

SOURCES OF WATER-USE INFORMATION IN MAINE.
Maine Geological Survey, Augusta. Dept. of Conservation.
For primary bibliographic entry see Field 6D.
W91-00443

SPATIAL ALLOCATION FACTOR PROCEDURES FOR THE 1980 NAPAP (NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM) EMISSIONS INVENTORY DOCUMENTATION.
Alliance Technologies Corp., Bedford, MA.
For primary bibliographic entry see Field 5B.
W91-00453

BASIS OF HYDRO-CLIMATIC TIME SERIES IN GREENLAND.
Greenland Technical Organization, Copenhagen (Denmark). Section of Hydro-Technical Investigation.
T. Thomsen.
IN: Remote Sensing and Large-Scale Global Processes. IAHS Publication No. 186. International Association of Hydrological Sciences, Wallingford, England. 1989. p 139-150, 7 fig, 6 ref, append.

Descriptors: *Climatology, *Greenland, *Hydrologic budget, *Network design, *Statistical analysis, *Time series analysis, Arctic zone, Data interpretation, Mathematical analysis, Model studies.

Reliable and continuous time series of hydroclimatic parameters in Greenland exist only for a few stations. Time series determination for hydro-technical projects is performed with the use of a station technology making possible immediate use of approved data through recursive algorithms. An evaluation of parameters for statistical purposes for other localities and for other times than the measured can be estimated using models calibrated using time series analyses, satellite images and digital maps. The combination of transfers of place and time data makes it possible to solve hydrotechnical problems with only a limited number of time series data. (See also W91-00454) (Author's abstract)
W91-00469

MULTISPECTRAL SNOW AREA ALGORITHM FOR OPERATIONAL 7-DAY SNOW COVER MONITORING.
Bristol Univ. (England). Remote Sensing Unit.
For primary bibliographic entry see Field 2C.
W91-00471

FREQUENCY DISTRIBUTIONS OF HEAVY RAINSTORMS IN ILLINOIS.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2B.
W91-00553

PESTICIDES IN GROUND WATER DATA BASE: 1988 INTERIM REPORT.
Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.
For primary bibliographic entry see Field 5B.
W91-00569

ENHANCEMENT OF THE HWRIC DATABASE, YEAR 2. WITH AN EVALUATION OF DATABASE CONTENT.
Illinois State Water Survey Div., Champaign. Ground-Water Section.
S. C. Schock, M. M. Peyton, and E. P. Mills.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-197099. Price codes: A05 in paper copy, A01 in microfiche. Report No. HWRIC RR-024, June 1988. 76p, 26 fig, 15 tab, 5 ref, 2 append. State of Illinois Department of Energy and Natural Resources Contract Nos. HWR87-005 and STILENR-1-5-39133.

Descriptors: *Computer programs, *Data acquisition, *Data storage and retrieval, *Databases, *Hazard Waste Research and Information C, Computers, Hazardous wastes, Illinois.

The Hazardous Waste Research and Information Center (HWRIC) database has been in the development and enhancement stages for three years. The method for collection and addition of historic data has evolved over the years as the available information has become more familiar and better understood by database users. Evaluation of the relative contribution to the HWRIC database of the available large-volume computerized datasets and the hand gathered historic data has been an on going process. These analyses have yielded valuable information on the quality and quantity of data now available in the HWRIC database system. Analysis of data serves two major purposes: (1) to demonstrate the descriptive value of the data in the Hazardous Sites Inventory file. This aspect is important in extracting those site that are to be used for research or information; and (2) to evaluate the relative contribution to the HWRIC database from regulatory computer source files, non-regulatory source files, non-regulatory computer source files, and Illinois State Water Survey. (Author's Abstract)
W91-00571

QUALITATIVE VALIDATION OF POLLUTANT TRANSPORT COMPONENTS OF AN UNSATURATED SOIL ZONE MODEL (SESOIL).
Oak Ridge National Lab., TN. Computing and Telecommunications Div.
For primary bibliographic entry see Field 5B.
W91-00573

EXACT SOLUTION FOR FLOW OF SLIGHTLY COMPRESSIBLE FLUIDS THROUGH MULTIPLE-POROSITY, MULTIPLE-PERMEABILITY MEDIA.
Scientific Research Inst. of Petroleum Exploration and Development, Beijing (China).
For primary bibliographic entry see Field 2F.
W91-00588

COKRIGING TO ASSESS REGIONAL STREAM QUALITY IN THE SOUTHERN BLUE RIDGE PROVINCE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W91-00589

RAINFALL-RUNOFF RELATIONS DERIVED FROM THE PROBABILITY THEORY OF STORAGE.
IBM Research Lab., Yorktown Heights, NY.
For primary bibliographic entry see Field 2E.
W91-00592

ANALYTICAL SOLUTIONS OF THE ONE-DIMENSIONAL ADVECTION EQUATION AND TWO OR THREE-DIMENSIONAL DISPERSION EQUATION.
Auburn Univ., AL. Dept. of Agronomy and Soils.
For primary bibliographic entry see Field 5B.
W91-00594

FUZZY REGRESSION IN HYDROLOGY.
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft.
A. Bardossy, I. Bogardi, and L. Duckstein.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1497-1508, July 1990. 14 fig, 2 tab, 27 ref, 2 append. U.S. National Science Foundation Grant ECS-8812350, ECS-8802920; U.S. Geological Survey, Grant 14-08-0001-G1503.

Descriptors: *Data interpretation, *Mathematical analysis, *Model studies, *Regression analysis, *Statistical methods, Case studies, Decision making, Fuzzy regression, Hydrologic data.

A general methodology for fuzzy regression was developed and illustrated by hydrological case study. Fuzzy regression may be used whenever a relationship between variables is imprecise and/or sample sizes are insufficient. In such cases fuzzy regression may be used as a complement or alternative to statistical regression analysis. In fuzzy regression, several 'goodness of fit' criteria may be used, such as the maximum average vagueness criterion and the prediction vagueness criterion. The technique is illustrated by means of a case study involving the relationship between soil electrical resistivity and hydraulic permeability. This relationship is imprecise and based on only a few data points. A curvilinear relationship was fitted using fuzzy regression with six calculated resistivities and six measured permeabilities. Prediction vagueness criteria appears to yield a more robust fuzzy regression than the maximum average vagueness criteria. Potential application areas of fuzzy regression in hydrology include expression of the uncertainty in discharge curves, modeling water quality and quantity relationships, sediment transport and river flow relationships, estimation of aquifer parameters, flow in fractured rocks, health risk analyses, and functions expressing cost, economic loss and benefit of hydrologic works. The methodology is relatively simple, and the results can be interpreted to provide a valuable hydrological decision-making aid. (Author's abstract)
W91-00596

EFFICIENT DETERMINISTIC-PROBABILISTIC APPROACH TO MODELING REGIONAL GROUNDWATER FLOW: 1. THEORY.
California Univ., Irvine. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-00601

EFFICIENT DETERMINISTIC-PROBABILISTIC APPROACH TO MODELING REGIONAL GROUNDWATER FLOW: 2. APPLICATION TO OWENS VALLEY, CALIFORNIA.
California Univ., Irvine. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-00602

ASSESSMENT OF A CONCEPTUAL RAINFALL-RUNOFF MODEL'S ABILITY TO REPRESENT THE DYNAMICS OF SMALL HYPOTHETICAL CATCHMENTS: 1. MODELS, MODEL PROPERTIES, AND EXPERIMENTAL DESIGN.
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W91-00604

MODEL OF ORGANIC CHEMICAL UPTAKE AND CLEARANCE BY FISH FROM FOOD AND WATER.
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
For primary bibliographic entry see Field 5B.
W91-00622

DAILY FLOW FORECASTING WITH REGRESSION ANALYSIS.
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 2E.
W91-00634

PREDICTING SUCCESS OF WALLEYE STOCKING PROGRAMS IN THE UNITED STATES AND CANADA.
Idaho Univ., Moscow. Coll. of Forestry.
For primary bibliographic entry see Field 8I.
W91-00691

DISCHARGE CHARACTERISTICS OF LOCAL DISCONTINUOUS CONTRACTIONS, II.
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
For primary bibliographic entry see Field 8B.
W91-00762

PERTURBATION SOLUTION OF THE FLOOD-ROUTING PROBLEM.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 2, p 215-234, 1987. 13 fig, 8 ref.

Descriptors: *Channels, *Flood routing, *Flow pattern, *Kinematic wave theory, *Mathematical studies, *Routing, *Theoretical analysis, Boundary conditions, Flow, Hydrographs, Model studies, Rapid flow, Tranquil flow, Weirs.

Singular perturbation techniques are used to obtain an approximate solution of the flood routing problem. The first-order outer solution is given by the kinematic-wave approximation. Singularities in this outer solution then lead to two inner solutions: one that follows a kinematic shock as it moves downstream and one either at the downstream boundary in subcritical flow or at the upstream boundary in supercritical flow. Solutions calculated in each of these subregions allow conclusions to be drawn about the relative importance of various terms in the momentum equation. In the first-order approximation, inserting a downstream weir or channel obstruction in subcritical flow changes depths but not flow rates within the associated boundary layer. This suggests that flow rate hydrographs in an irregular channel can be approximated with flow rate hydrographs calculated for a prismatic, rectangular channel. However, depth hydrographs for the irregular channel would have to be approximated by using the calculated flow rates in either a calculated or measured rating curve that includes the effect of channel irregularities. The inner and outer solutions are combined to obtain composite solutions for flow depths and flow rates, and a numerical example is worked. (Agostine-PTT)
W91-00763

CONTROL OF PHYTOPLANKTON GROWTH IN NUTRIENT RECYCLING ECOSYSTEMS. THEORY AND TERMINOLOGY.
Bergen Univ. (Norway). Dept. of Microbiology and Plant Physiology.
For primary bibliographic entry see Field 2H.
W91-00765

VARIABILITY OF RESULTS FROM THE USE OF PHABSIM IN ESTIMATING HABITAT AREA.
Melbourne Univ., Parkville (Australia). Dept. of Civil and Agricultural Engineering.
K. Gan, and T. McMahon.
Regulated Rivers Research & Management RRRMEP, Vol. 5, No. 3, p 233-239, June/July 1990. 1 tab, 9 ref.

Descriptors: *Computer models, *Computer programs, *Habitats, *Instream Flow Incremental Methodology, Fish, Invertebrates, River systems, Variability.

The estimation of the area of a stream reach suitable as habitat for an aquatic species was made using the Instream Flow Incremental Methodology, (the collection of computer models and analytical procedures designed to predict changes in fish or invertebrate habitat changes due to flow changes). An important component of the methodology is PHABSIM, which is a collection of computer programs whereby useable stream area is computed as a function of discharge. This method comprises a variety of options for both hydraulic and habitat simulation. A single data set was used to calculate the useable area at one discharge for three life stages of brown trout using various options in habitat simulation. The results varied greatly according to the particular combination of options selected. Therefore, unless calculations are founded on biologically realistic assumptions, the potential within PHABSIM for the fudging of results is considerable. (Author's abstract)
W91-00775

INFILTRATION UNDER PONDED CONDITIONS: 3. A PREDICTIVE EQUATION BASED ON PHYSICAL PARAMETERS.
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 2G.
W91-00790

INFLUENCE OF OUTLIERS ON RESULTS OF WET DEPOSITION MEASUREMENTS AS A FUNCTION OF MEASUREMENT STRATEGY.
Netherlands Energy Research Foundation ECN, Petten.
For primary bibliographic entry see Field 5B.
W91-00849

SOURCE-RECEPTOR RELATIONSHIPS FOR WET SO4(2-) AND NO3(-) PRODUCTION.
For primary bibliographic entry see Field 5B.
W91-00851

EFFECTS OF FAULTS ON FLUID FLOW AND CHLORIDE CONTAMINATION IN A CARBONATE AQUIFER SYSTEM.
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-00877

THEORY AND APPLICATION OF AN APPROXIMATE MODEL OF SALTWATER UPCONING IN AQUIFERS.
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 2F.
W91-00883

NON-LINEAR SYSTEM TO DESCRIBE MOVEMENTS OF WATER MASSES AT THE LG-2 RESERVOIR (LA GRANDE, QUEBEC).
Sherbrooke Univ. (Quebec). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2H.
W91-00885

RAINFALL DEFICITS: DISTRIBUTION OF MONTHLY RUNS.
Canterbury Regional Council, Christchurch (New Zealand).
For primary bibliographic entry see Field 2B.
W91-00886

NOTE ON THE ANALYSIS OF MOISTURE-DEPTH CURVES OBTAINED BY THE HOT-AIR METHOD FOR THE DETERMINATION OF SOIL MOISTURE DIFFUSIVITY.
Botswana Univ., Gaborone. Dept. of Geology.
For primary bibliographic entry see Field 2G.
W91-00889

GEOSTATISTICAL METHODS FOR DETECTION OF OUTLIERS IN GROUNDWATER QUALITY SPATIAL FIELDS.
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft.
For primary bibliographic entry see Field 2F.
W91-00894

CLASSIFICATION OF SHALLOW GROUNDWATER TYPES IN A DUTCH COVERSAND LANDSCAPE.
Amsterdam Univ. (Netherlands). Landscape and Environmental Research Group.
For primary bibliographic entry see Field 2K.
W91-00895

NEW DIRECTIONS FOR SURFACE WATER MODELING.
Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181. International Association of Hydrological Sciences, Washington, DC. 1989. 444p. Edited by M. L. Kavvas.

Descriptors: *Drought, *Expert systems, *Floods, *Hydrologic models, *Hydrology, *Physical models, *Rainfall, *Surface water, *Water management, Symposium.

This volume presents the proceedings of a symposium on hydrologic modeling held during the Third Scientific Assembly of the International Association of Hydrological Sciences at Baltimore, Maryland, in May 1989. The symposium was organized by the International Association of Hydrological Sciences International Commission on Surface Water. The volume contains 43 papers from 24 countries, grouped under 6 topics: Rainfall fields; Physics-based hydrologic models; Rainfall-runoff models; Floods; Droughts; and Geographic information, decision support and expert systems. (See W91-00961 thru W91-01004) (Sand-PTT)
W91-00961

TOWARDS AN IMPROVED SYSTEM FOR WEATHER RADAR CALIBRATION AND RAINFALL FORECASTING USING RAINGAUGE DATA FROM A REGIONAL TELEMETRY SYSTEM.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2B.
W91-00963

AREAL REDUCTION FACTORS FOR DESIGN STORM CONSTRUCTION: JOINT USE OF RAINGAUGE AND RADAR DATA.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2B.
W91-00965

ACCURACY OF THE MAXIMUM RECORDED DEPTH IN EXTREME RAINSTORMS.
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W91-00966

PHYSICS-BASED APPROACH TO STOCHASTIC HYDROLOGY OF FIRST-ORDER DRAINAGE BASINS.
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00968

ENTROPY BASED METHOD FOR FLOOD FORECASTING.
Louisiana Geological Survey, Baton Rouge.
For primary bibliographic entry see Field 2E.
W91-00972

ASSESSMENT OF NETWORK MODELS IN FLOOD FORECASTING.
Bureau of Meteorology, Hobart (Australia).
For primary bibliographic entry see Field 2E.
W91-00973

REAL-TIME INTERCOMPARISON OF HYDROLOGICAL MODELS.
World Meteorological Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 2A.
W91-00974

FLOODS AND DROUGHTS IN LABE RIVER BASIN: THE HYDROGRAPH SHAPE.
Hydrometeorologicky Ustav, Prague (Czechoslovakia).
For primary bibliographic entry see Field 2E.
W91-00975

MODELLING OF HYDROLOGICAL PROCESSES FOR A MOUNTAINOUS BASIN.
Tokyo Metropolitan Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W91-00976

REGIONAL METHODS FOR ESTIMATION OF DESIGN FLOODS FOR SMALL TO MEDIUM SIZED DRAINAGE BASINS IN AUSTRALIA.
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00986

DETERMINATION OF DESIGN FLOOD HYDROGRAPHS BASED ON REGIONAL HYDROLOGICAL DATA.
Graz Univ. (Austria). Inst. for Hydromechanics, Hydraulics and Hydrology.
For primary bibliographic entry see Field 2E.
W91-00987

REGIONAL ANALYSIS OF THE MEAN ANNUAL FLOOD AND OF FLOOD FREQUENCY CHARACTERISTICS.
National Technical Univ., Athens (Greece). Div. of Water Resources.
For primary bibliographic entry see Field 2E.
W91-00988

REGIONAL FLOOD FREQUENCY ANALYSIS USING RIDGE REGRESSION.
Hydro-Quebec, Montreal.
For primary bibliographic entry see Field 2E.
W91-00990

REGIONALIZATION OF LOW FLOW CHARACTERISTICS USING LOGISTIC AND GLS REGRESSION.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W91-00993

DERIVING STREAM PARAMETERS FOR HYDROLOGIC MODELING FROM DIGITAL ELEVATION DATA.
Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.
For primary bibliographic entry see Field 2E.
W91-01000

INTELLIGENT GEOGRAPHIC INFORMATION SYSTEMS (IGIS) AND SURFACE WATER MODELING.
Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Wasserbau und Wasserwirtschaft und Inst. fuer Wasserbau.
For primary bibliographic entry see Field 4A.
W91-01001

ENVIRONMENTAL GEOGRAPHIC INFORMATION SYSTEM IN FINLAND.
National Board of Waters, Helsinki (Finland).
Y. Sucksdorff, R. Lemmela, and T. Keisteri.
IN: New Directions for Surface Water Modeling. Proceedings of a Symposium held in Baltimore, Maryland, May 1989. IAHS Publication No. 181.

International Association of Hydrological Sciences, Washington, DC. 1989. p 427-434. 5 fig, 2 tab, 4 ref.

Descriptors: *Databases, *Finland, *Geographic information systems, *Hydrologic data, Catchment areas, Data acquisition, Environmental quality, Land use, Remote sensing, Satellite technology, Water quality.

An environmental geographic information system called Figure Information System has been constructed in Finland. This system is the basis of an environmental data system which contains all registers for environmental protection purposes, including hydrological and water quality registers. The operational part of the system consists of digitalized drainage basin divides, terrain heights, administrative borders, basin characteristics interpreted from land-use satellite images, and a connection to an observation point register. (See also W91-00961) (Author's abstract)
W91-01003

8. ENGINEERING WORKS

8A. Structures

THREE-DIMENSIONAL ANALYSIS OF PRESSURES ON DAMS.
Sinotech Engineering Consultant, Inc., Taipei (Taiwan).
For primary bibliographic entry see Field 8B.
W91-00057

NONLINEAR HYDRODYNAMIC PRESSURE ON DAMS.
Pittsburgh Univ., PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00058

AIR ENTRAINMENT BY SPILLWAY AERATORS.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 8B.
W91-00061

DIMENSIONLESS ANALYTICAL SOLUTIONS FOR DAM-BREACH EROSION.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and C. A. Quiroga.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 2, p 179-197, 1988. 9 fig, 4 tab, 8 ref.

Descriptors: *Accelerated erosion, *Dam failure, *Dams, *Earth dams, *Erosion, *Hydraulic structures, *Mathematical models, *Model studies, Flood data, Flood discharge, Floods.

Experience with physically based dam-break models such as the BEED model has shown that the utilization of sediment transport theories involves making assumptions beyond the original ranges stipulated in the models. Defining the rate of erosion in terms of a single factor simplifies the mathematical solution so that an analytical solution becomes possible. Earthen dam breach erosion was analyzed using dimensionless analytical solutions, with rectangular and triangular representations for the breach section. Data for the historical failures of the South Fork Dam near Johnstown, PA and Teton Dam in Idaho were used to test these solutions. The closed form dimensionless analytical solutions properly simulated dam breach erosion. Estimates of breach formation time, based upon the dimensionless solutions, were highly dependent on the empirical erodibility factor. However, peak discharge did not appear to be sensitive to the erodibility factor. The study results coincide with the influence of the friction factor in the BEED model. (Tappert-PTT)
W91-00069

FLOODING CONTROLLED BY BRIDGE RELOCATION.
Edwards and Kelcey, Inc., Minneapolis, MN.
For primary bibliographic entry see Field 4A.
W91-00105

THREE-DIMENSIONAL BOUNDARY ELEMENT RESERVOIR MODEL FOR SEISMIC ANALYSIS OF ARCH AND GRAVITY DAMS.
National Research Council of Canada, Ottawa (Ontario). Inst. for Research in Construction.
For primary bibliographic entry see Field 8D.
W91-00123

SEISMIC DAMAGE TO SEGMENTED BURIED PIPELINES.
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8G.
W91-00124

SIPHON QUENCHES.
Ketchikan Pulp Co., AK.
D. B. Loitz, A. L. deSteiguer, and W. R. Broz.
Civil Engineering (ASCE) CEWRA9, Vol. 60, No. 8, p 44-46, August 1990. 2 fig.

Descriptors: *Alaska, *Hydraulic engineering, *Pipes, *Siphons, *Water conveyance, Civil engineering, Design criteria, Drought, Economic aspects, Pulp and paper industry, Water supply development.

During the drought in the summer of 1989, in Ketchikan, Alaska, water measurements at the Lake Connell Dam reservoir revealed that, at the local pulp mill's normal usage rate, only three weeks of water remained. With 600 job layoffs imminent, the pulp company considered alternative water supplies and settled on a lake located south of Lake Connell at a higher elevation. It was decided to transfer the water from one lake to the other through an 1,800-foot flexible siphon. The nearly dry creek bed linking the two lakes formed an obvious route for the siphon, with a natural crown making for an acceptable rise from lake level existing in the form of a log dam at the head of the creek. Engineers found that lowering the lake by 20 feet would result in an operational time of 57 days at 20 million gallons per day, equivalent to a month's usage by the mill at full capacity--making the project economically viable and providing a bridge to the next rainy season. Because of the need to protect the surrounding habitat and a prohibition on mechanized equipment, it was necessary to construct the pipe of a lightweight, flexible, and rugged high-density polyethylene, which was quickly airlifted in along with the necessary personnel and equipment. 45 Tons of 24-in pipe was fused together at the principal work area just downstream of the lake outlet in 600-foot segments, then pulled into place by chain-saw winches, comealongs, and rollers. Solid axial restraint was provided by jointing, rather than thrust-blocking. The pipe wall thickness at the crown was specified to be sufficient for the design vacuum, to avoid pipe collapse. The relative simplicity of a siphon belies the difficulty of its construction, especially in the rugged terrain of Alaska. (Fish-PTT)
W91-00142

SHAKE TABLE TEST OF CYLINDRICAL WATER TANKS IN BASE-ISOLATED STRUCTURES.
Parsons (Ralph M.) Co., Pasadena, CA.
For primary bibliographic entry see Field 8E.
W91-00147

VORTEX DROP INLET FOR SUPERCRITICAL APPROACHING FLOW.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
W. H. Hager.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 8, p 1048-1054, August 1990. 7 fig, 9 ref.

Descriptors: *Hydraulic engineering, *Hydraulic structures, *Inlets, *Rapid flow, *Vortices, Critical flow, Froude number, Hydraulic geometry, Optimization, Standing waves.

A vortex drop consists of the inlet structure, the drop shaft, and the outlet works. The inlet structure may either be spiral-shaped or tangential. Drop inlets for supercritical approach flow may occur at relatively small bottom slopes of typically 0.5%. Based on detailed experimental observations collected at various inlet geometries, the shape of vortex inlet was optimized. The geometry recommended is of spiral shape, and depends mainly on the shaft radius and on the width of the approaching channel. Particular features of the inlet are its wide domain of application regarding the Froude number and bottom slope of the approaching channel, and zero transverse inlet slope. The discharge capacities of vortex drops were shown to be of the same order for both subcritical and supercritical approach flows. Further, the surface profile along the outer guiding wall was analyzed. It was found that both the Froude number of the approach flow and the radius of outer inlet wall influence significantly the maximum height of standing wave. The discharge of the drop shaft for both subcritical and supercritical flow are found to be about the same. (Fish-PTT)
W91-00153

HYDROLOGIC PARAMETER EFFECTS ON SMALL-DAM RISK ANALYSIS IN MISSOURI.
Missouri Univ.-Columbia. Dept. of Civil Engineering.
R. L. Peyton, and A. R. Kalmes.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 465-478, July/August 1990. 6 tab, 19 ref.

Descriptors: *Cost analysis, *Dam failure, *Dam inspection, *Dam safety, *Dam stability, *Missouri, *Risk analysis, Antecedent moisture, Drainage engineering, Probability distribution, Rainfall distribution, Sensitivity analysis.

The U.S. Army Corps of Engineers found that Missouri had the largest number of 'unsafe-emergency' dams in the nation. Since then, the state's dam safety council has established a permit program. The sensitivity of risk cost to hydrologic parameters was evaluated to determine the feasibility of risk analysis as an alternative approach to existing requirements for rehabilitation of small dams in Missouri. The sensitivity to probable maximum precipitation (PMP) exceedance probability is greatly reduced by interpolating rainfall exceedance probabilities between the PMP and the rainfall depth that initiates failure, instead of the PMP and the 100-year return period depth. This approach also reduces by a small amount the sensitivity of risk cost to the assumed probability distribution function. Variations in the time distribution of rainfall and the antecedent moisture condition (AMC) have a large influence on risk cost. Probabilistic combinations of the three AMC classes result in risk costs within 13% of the risk cost using AMC II, the 'average' condition. Of the three dam-breach parameters evaluated, risk cost is most sensitive to breach-development time and least sensitive to breach side slopes. (Author's abstract)
W91-00167

SINGLE-OUTLET DETENTION-POND ANALYSIS AND DESIGN.
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
A. O. Akan.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 116, No. 4, p 527-536, July/August 1990. 4 fig, 1 tab, 7 ref.

Descriptors: *Detention reservoirs, *Drainage engineering, *Hydraulic design, *Mathematical models, *Reservoir design, *Storm water management, *Urban hydrology, Charts, Computer models, Finite difference methods, Hydraulic profiles, Hydrograph analysis, Outlets, Parametric hydrology, Ponds.

Storm water runoff is controlled using detention ponds in many new communities. A desktop method was developed to analyze or size detention ponds and outlet facilities. Different initial conditions were allowed. When used for design purposes, the method determines the size of the outlet facility for a given pond. However, if the pond is inadequate to meet the design criteria set, the method determines the required stage-storage relationship. The method is based on the usual reservoir-routing technique that couples the hydrologic-storage equation with an expression describing the flow through the outlet structure. The equations are rearranged in terms of several dimensionless parameters. A computer model is used to solve the governing equation using a finite difference scheme. The numerical results obtained in terms of systematically chosen combinations of the governing dimensionless parameters are generalized based on the concept of similarity. A family of charts has been developed for quick analysis and preliminary design of single-outlet detention ponds. The mathematical model used in developing these charts has been tested and verified with analytical solutions. The major limitation of the pond charts is that they have been derived for inflow hydrographs of a specific shape. However, the shape chosen should represent most natural basins well. Moreover, considering the uncertainties involved in currently used hydrologic analysis techniques, errors arising from the assumed shape of a pond inflow hydrograph become insignificant. (Fish-PTT)
W91-00171

IMPROVEMENT OF BYPASSING AND BACKPASSING AT TIDAL INLETS.
P. Bruun.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 116, No. 4, p 494-500, July/August 1990. 5 fig, 12 ref.

Descriptors: *Bypass channels, *Coastal engineering, *Estuaries, *Hydraulic engineering, *Hydraulic structures, *Inlets, Beaches, Channel improvement, Dredging, Littoral drift, Longshore currents, Navigation channels.

Tidal inlets present a major barrier to longshore drift, particularly when they have been improved for navigation by dredged channels and/or jetties. Simulation models are useful for the establishment of inlet material budgets. Available bypassing techniques are inadequate, for much material is lost and down-drift beaches suffer unreasonably. An improved bypassing technique seems possible based on much larger traps to intercept the littoral drift toward the inlet. The same equipment used for transfers can be applied to maintenance of channel depths. With present technology, too much material is lost to ocean and bay shoals. It may be recovered by using the same technology as for bypassing. Improved bypassing and backpassing technologies are being developed. More shallow water and special dredge-barge equipment is needed and will undoubtedly become available by the dredging industries overseas and in the United States. (Fish-PTT)
W91-00178

RISK OF DEBRIS-BASIN FAILURE.
Maryland Univ., College Park. Dept. of Civil Engineering.
R. H. McCuen, B. M. Ayyub, and T. V. Hromadka.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 116, No. 4, p 473-483, July/August 1990. 1 fig, 1 tab, 8 ref.

Descriptors: *Dam failure, *Debris basins, *Hydraulic engineering, California, Construction, Costs, Dredging, Hydraulic structures, Maintenance, Model studies, Precision, Rainfall, Watershed management.

Debris basins are a common engineering structure used to control debris flows. Knowledge of the risk of failure as a function of important design variables can improve decision making and can be used as a basis for minimizing the total annual cost (i.e., construction and maintenance plus risk cost). The failure risk was computed for four policy elements: the rainfall frequency, the interval between significant watershed burn, construction and dredging accuracy, and the regularity of maintenance of the debris basin. The burn interval and the rainfall magnitude are the two most important variables associated with the failure risk, with the expected annual risk varying from less than 1% to as much as 65% for different burn intervals and rainfall frequencies. A failure to maintain the basin can double the risk of failure. The risk of failure does not appear to change much for typical construction and dredging-volume accuracy. The risk estimates were made using a model developed from data from the southern California area and the conditional expectation variance reduction technique. (Author's abstract)
W91-00181

APPROPRIATE WELL DESIGN FOR DEVELOPING FRESH WATER AQUIFER IN A MIXED QUALITY AQUIFER SYSTEM.
Central Ground Water Board, Hyderabad (India).
K. V. J. R. Krupanidhi, V. S. S. Main, and N. Varadaraj.
IN: Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries. Volume I. Papers Presented at an International Workshop held February 28-March 4, 1989. A. A. Balkema, Rotterdam, The Netherlands. 1989. p 59-69, 3 fig, 1 tab, 4 ref.

Descriptors: *Aquifers, *Design standards, *Groundwater management, *Water resources development, *Well construction, Cements, Groundwater budget, Infiltration, Water quality, Well yield, Wells.

Guidelines are offered for the design of wells will be helpful in increasing the success rate of abstraction structures: (1) the groundwater potential, the elevation of the water table, its fluctuation, and the behavior of the fresh water-saline water interface must be visualized. The well design and pumping should have a minimum drawdown; (2) revitalization of poorly constructed infiltration wells can be made by horizontal filter points; (3) electrical logging of every borehole is necessary for the proper construction of tube wells in quality problem areas; (4) tube wells should be constructed with proper slot size, screen length, and gravel size; (5) the selection of cement sealing depth, depth range of gravel packing, margin for gravel sinking during development, sounding at different stages of well construction to check the desired depth of gravel and clay packing, as well as cement grouting are important factors for good production tube wells; and (6) fresh water aquifers without sufficient thickness of confining layers are likely to receive significant vertical leakage from other saline areas during pumping. In a group of mixed quality aquifers, only freshwater zones with considerable thickness of confining layers have to be tapped. (See also W91-00215) (Lantz-PTT)
W91-00221

INVISCID DAM-BREAK SOLUTION.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00376

FORCED AERATION OF HIGH VELOCITY FLOWS.
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
J. Bruschin.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 1, p 5-14, 1987. 1 fig, 2 tab, 22 ref, append.

Descriptors: *Aeration, *Cavitation, *Dam design, *Dams, Air entrainment, Design criteria, Forced aeration, High velocity flow, Hydraulic structures, Mathematical models.

Cavitation damage and its prevention are of increasing concern to designers and operators of large dams. Forced aeration of the wall jets results in an air-water mixture that can have a considerably reduced bulk modulus and therefore can reduce or eliminate the cavitation damage potential in risk situations. Three key topics in the field of forced aeration were discussed: forced aeration mechanisms, predictions methods for air-flow rates, and model-prototype correlations. Forced aeration mechanisms cause the formation of an air-water mixture at the bottom of the boundary layer between the separation point of the wall jet and its reattachment. The approach flow conditions will dominate the air entrainment ability of the flow. With enough air coming from below and above, the uniform aerated flow condition will establish itself after a relatively short distance. Prediction methods for air flow rates were provided by (1) ad hoc theoretical considerations using the integral parameters of the flows with or without free parameters and/or correction factors; (2) similarity considerations with comparable, simpler, or solved flow problems; and (3) laboratory tests. A mathematical treatment of model-prototype correlations was examined in an appendix and data on prototype measurements for the Foz do Areia, Guri and Fengjiashan spillway aerators were used to evaluate air flow velocities and differential pressures, and jet roughness (surface disturbances) index. (MacKeen-PTT)
W91-00396

MODIFIED ELEMENT METHOD FOR PIPE NETWORK ANALYSIS.
Laval Univ., Quebec. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-00398

SIMULATION OF ONE-DIMENSIONAL DAM-BREAK FLOWS.
Florida International Univ., Miami. Dept. of Civil and Environmental Engineering.
R. J. Fennema, and M. H. Chaudhry.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 1, p 41-51, 1987. 7 fig, 18 ref, append.

Descriptors: *Dam failure, *Dams, *Model studies, *Rapid flow, *Simulation analysis, Flow models, One-dimensional flow, Surface flow, Tranquil flow, Unsteady flow.

Two new finite-difference schemes, were compared for the analysis of unsteady free surface flows resulting from the breaking of a dam. These schemes split the flux vector into positive and negative parts, each of which corresponds to the direction of a characteristic, thereby allowing use of proper finite differences for the space derivatives. Central finite differences are used for subcritical flow and upwind differences are used for supercritical flow. During real-life applications, if the ratio of initial upstream reservoir level to that on the downstream side of the dam following the failure of the dam is high, then supercritical flows are produced downstream of the dam. The schemes are attractive for solving the dam break problem, especially when supercritical flow is present. (Author's abstract)
W91-00399

SAFETY GOALS FOR HIGH-HAZARD DAMS: ARE DAMS TOO SAFE.
Carnegie-Mellon Univ., Pittsburgh, PA. Graduate School of Industrial Administration.
L. B. Lave, D. Resendiz-Carrillo, and F. C. McMichael.
Water Resources Research WRERAQ, Vol. 26, No. 7, p 1383-1391, July 1990. 2 fig, 4 tab, 39 ref.

Descriptors: *Cost-benefit analysis, *Dam failure, *Dam safety, *Dam stability, *Dams, *Design criteria, Emergency planning, Flood damage, Flood hazard, Probable maximum flood, Safety, Social costs.

The 1977 National Dam Inspection Program determined that many high-hazard dams in the United States were incapable of passing a probable maximum flood (PMF). Retrofitting these dams was estimated to cost at least $10 billion. Since the PMF is revised upward periodically, retrofit is a continual issue. But surviving a PMF is a more stringent safety criterion than preventing other sources of dam failure; in addition, it is more

stringent than safety criteria for other structures with respect to wind, earthquakes, or storm surges. This higher safety goal has large social costs. An alternative safety goal, separating property damage from possible loss of lives, is proposed. For a proposed dam whose failure could cause large loss of life or property damage, a careful evaluation should be done as to whether the dam should be built. For dams that impose smaller hazards, property damage should be handled by an analysis based on expected values of the annualized benefits and costs. An adjustment for scale could be used if the property damage were extremely large. Danger to lives should be handled by establishing programs to warn and evacuate people. This proposal should (1) lead to less injury and death, (2) use society's limited resources more efficiently, and (3) put the determination of safety goals on a more scientific and sensible basis. (Author's abstract)
W91-00587

SLIPS AHOY.
Johnson, Johnson and Roy, Inc., Ann Arbor, MI.
F. A. Klancnik.
Civil Engineering (ASCE) CEWRA9, Vol. 60, No. 5, p 59-61, May 1990.

Descriptors: *Boating, *Docks, *Marinas, *Recreation facilities, Design criteria, Environmental impact, Harbors, Land development, Management planning.

Although the market for boat docking facilities will remain substantial in the 1990s, the construction of marinas is not expected to increase due to lack of developable sites, as seen in California, and increased capital expenditure requirements. The opening of the Tennessee-Tombigbee Waterway has increased marina demand in the central Gulf region. Several trends will help to alleviate demand pressures for new marinas. Research and engineering of the past decade have led to more effective floating dock systems and wave attenuators; where water levels fluctuate more than 2 or 3 ft, as in the Great Lakes marinas, floating systems will dominate the market. Sophisticated modeling techniques and government-sponsored research are generating better and more cost-effective methods of protecting harbors and shorelines. Larger boats are increasing the spatial requirements for docking facilities and landside development costs are increasing as boat owners come to look upon the marina as a center of leisure activity. Long-term leasing of dock space is helping developers to recover the initial capital expenditures for building new dock sites. Public awareness of the environmental impact of marina construction is lengthening the planning and design time required before permits are secured and construction can begin. (Geiger-PTT)
W91-00677

MICROTUNNELING TECHNIQUES AID SEWER INSTALLATION.
Houston Dept. of Public Works, TX.
P. D. Barnhard, and J. E. Pate.
Public Works PUWOAH, Vol. 121, No. 8, p 69-70, 1990. 3 fig.

Descriptors: *Houston, *Microtunneling, *Sewer systems, *Texas, *Wastewater collection, Economic aspects, Gravity relief sewers, Noise, Pipelines, Public relations, Sanitary engineering.

As the River Oaks area of Houston developed, problems with the wastewater collection system multiplied and the system became heavily overloaded, which resulted in frequent system overflows. By the 1980's, the area required numerous wastewater system improvements. Because the same problem existed throughout Houston, the department of public works developed a comprehensive plan of wastewater improvements. To minimize disruption to the area during construction, the public works department selected the microtunneling technique for installing gravity sewer lines, rather than conventional open cut construction. The River Oaks project required the construction of 20000 feet of 8 inch through 21 inch gravity relief sewers, various appurtenances, two lift stations, and related force mains. Microtunneling is a method of installing pipes as small as ten inches in diameter by pipe jacking techniques. The machines operate from a jacking pit and the pipe is jacked in precise alignment toward a target. The microtunneling machine excavates material from its path as it is jacked forward from the starting pit. As the pipe is jacked forward, the soil ahead of it is removed and transported by slurry line or auger through a smaller pipe inside the one being jacked in place. Groundwater levels varied from 8 to 30 feet below the ground surface. The River Oaks sanitary sewer line varied in depth from 8 to 25 ft both above and below the water table depending on circumstances. Prices for microtunneling vary depending upon a variety of factors or cost determinants, including depth, pipe size, soil conditions, accessibility of the area, pit location, pipe type, and length of push involved. Microtunneling does have certain disadvantages, however, that should be considered when evaluating this construction alternative. Construction time from set-up to completion is lengthened; shafts for lateral sewer lines as well as the primary relief line are open longer than is required for conventional construction; and, microtunneling is a costly construction alternative. The microtunneling techniques does, however, significantly minimize business and neighborhood disruption, and avoids much of the noise associated with typical utility construction project. (Brunone-PTT)
W91-00773

SYNTHETIC LININGS.
Hovater Engineers, Laguna Hills, CA.
For primary bibliographic entry see Field 5E.
W91-00949

8B. Hydraulics

LOCAL SCOUR PROFILES DOWNSTREAM OF HYDRAULIC JUMP.
Ministry of Energy, Tehran (Iran).
J. Farhoudi, and K. V. Smith.
Journal of Hydraulic Research JHYRAF, Vol. 23, No. 4, p 343-358, 1985. 12 fig, 1 tab, 9 ref.

Descriptors: *Channel morphology, *Channel scour, *Flow characteristics, *Hydraulic geometry, *Hydraulic jump, *Hydraulic models, *Sediment transport, Bed load, Mathematical studies, Model studies, Suspended sediments.

The development over time of local scour holes downstream of a hydraulic-jump-type flow shows certain geometrical similarities. These similarities exist both in the process of scour and in the profiles that the scour holes follow downstream of hydraulic-jump flow. An investigation was carried out using three geometrically-similar models with the geometrical scale progressing by a factor of two. The sediment movement was governed by material moved in suspension for the initial period of scour. The suspension process was intensified by decreasing the weight of the sediment, increasing the flow, or lowering the tailwater. The suspension movement changed to bed-load movement with the passage of time. This type of scour differs from scour under vertical and plunging jets in which the suspension process predominates. But it is in agreement with scour reported from below horizontal jets. Among the characteristic geometric parameters of the scour hole a relationship exists which, for similar conditions, makes it possible to select only one of these parameters to describe all the scour hole geometry. The derived coefficients are independent of sediment properties although influenced by geometry and intensity of flow. The definition of the scour profile makes it possible to predict the volume of sediment removed from the scour hole at any time provided the corresponding maximum depth of scour is known. (Stoehr-PTT)
W91-00032

HYDRAULIC JUMPS AT POSITIVE AND NEGATIVE STEPS.
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
W. H. Hager, and N. V. Bretz.
Journal of Hydraulic Research JHYRAF, Vol. 24, No. 4, p 237-253, 1986. 14 fig, 15 ref, append.

Descriptors: *Channel morphology, *Flow characteristics, *Hydraulic geometry, *Hydraulic jump, *Stilling basins, Critical flow, Froude number, Hydraulic design, Standing waves, Tailwater.

The hydraulic flow features associated with a hydraulic jump over positive and negative steps were investigated. To facilitate the design of stilling basins, emphasis was placed on extreme values of the variables. In particular, the sequent depths ratio, the length characteristics, and the wave formation were analyzed by elementary means and confirmed by observations. The relations for the sequent depths ratios were in agreement with the data analyzed. The shape of the step was insignificant provided the transition from super to subcritical flow conditions prevailed at the step. The sequent depth ratio depended only on the relative step height, and the approaching Froude number, F1. The relative length of the standing wave was also a function of F1. Negative steps had approximately six times more variation in tailwater depth. For higher F1 values, the dissipation of all hydraulic jumps was approximately equal and corresponded to that of a hydraulic jump in a horizontal channel. The hydraulic jump at a positive step was more compact than that at a negative step. (Stoehr-PTT)
W91-00034

CONCENTRATION OF VERY FINE SILTS IN A STEADY VORTEX.
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 2J.
W91-00035

VELOCITY DISTRIBUTION IN ALLUVIAL CHANNEL FLOW.
Karnataka Regional Engineering Coll., Suratkal (India). Dept. of Civil Engineering.
B. R. Samaga, K. G. Ranga Raju, and R. J. Garde.
Journal of Hydraulic Research JHYRAF, Vol. 24, No. 4, p 297-308, 1986. 9 fig, 1 tab, 9 ref.

Descriptors: *Alluvial channels, *Channel flow, *Sediment transport, *Sediment-water interfaces, *Streambeds, *Velocity distribution, Mathematical models, Momentum transfer, Rhine River, Rio Grande, Suspended sediments.

The velocity distribution equations which have been developed recently using data on sediment-laden flow over a rigid plane bed were checked with experimental data for flow over alluvial beds of sediment mixtures and found to be unsatisfactory for this case. Making use of data from various sources, a two-layer model of velocity distribution over alluvial beds was developed. In this model it was assumed that, in the region where distance from the bed is less than 0.2 times the depth of flow, the momentum-transfer coefficient is a constant. This assumption was made in the light of the fact that, due to high sediment concentration and intense turbulence, the flow in this region is complicated, and the value of the momentum-transfer coefficient is different from its value for the region where distance from the bed is greater than one fifth of the depth of flow. The model agrees with field measurements of the Rhine and the Middle Rio Grande. (Stoehr-PTT)
W91-00036

FLOW RESISTANCE IN COMPOUND CHANNELS.
Ulster Univ. at Jordanstown, Newtownabbey (Northern Ireland). Dept. of Civil Engineering and Transport.
For primary bibliographic entry see Field 2E.
W91-00037

IMPROVED METHOD OF CALCULATION FOR STEADY UNIFORM FLOW IN PRISMATIC MAIN CHANNEL/FLOOD PLAIN SECTIONS.
Queen Mary Coll., London (England). Dept. of Civil Engineering.

P. R. Wormleaton, and D. J. Merrett.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 2, p 157-174, 1990. 9 fig, 1 tab, 29 ref.

Descriptors: *Channel flow, *Flood plains, *Hydraulics, *Open-channel flow, *Steady flow, *Uniform flow, Discharge measurement, Hydraulic models, Mathematical studies, Regression analysis, Shear stress.

Experimental results are presented from the Science and Engineering Research Council Flood Channel Facility at Hydraulics Research, Wallingford, for discharge and boundary shear stress distribution in symmetrical compound channel/flood plain sections of varying flood plain width and roughness. These are used to assess the performance of several standard discharge calculation methods, which assume different locations of the interface between main channel and flood plain subareas. It is shown that these methods can produce large errors in total and component discharges, which increase significantly with flood plain width and roughness. A modified form of the above methods is discussed, which makes a more realistic allowance for interaction at the main channel/flood plain interface. It achieves this by incorporating the Radojkovic indices to characterize momentum transfer between adjacent subareas into the calculation. This modified method is shown to be considerably more accurate than the standard methods in calculating total and component discharges. A tentative regression equation is presented for calculating Radojkovic indices from easily identifiable cross section characteristics. (Author's abstract)
W91-00038

TURBULENCE MEASUREMENTS IN A SHEAR LAYER REGION OF A COMPOUND CHANNEL.
Birmingham Univ. (England). Dept. of Civil Engineering.
D. W. Knight, and K. Shiono.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 2, p 175-196, 1990. 17 fig, 30 ref.

Descriptors: *Hydraulic models, *Open-channel flow, *Shear stress, *Turbulence, *Turbulent flow, Boundary processes, Eddies, Flood plains, Flow measurement, Momentum transfer, Upwelling.

The Science and Engineering Research Council Flood-Channel Facility at Hydraulics Research Ltd., Wallingford, England, represents a large-scale model of a river system with floodplains, and is designed to produce fully-developed boundary-layer flows with transverse shear. Some of the preliminary open-channel flow data, including turbulence measurements, performed in the facility are presented. The vertical distributions of primary velocity are essentially logarithmic in regions of a compound channel where the lateral shear stresses are low. Where the logarithmic law applies, the vertical distributions of turbulent intensity and kinetic energy follow standard forms and the appropriate empirical coefficients have been determined. The spatial distributions of primary velocity, turbulent intensity, kinetic energy, and Reynolds stresses are given for two overbank flows. In regions where there is high lateral shear superimposed on bed-generated turbulence, the vertical distributions of Reynolds stress are highly nonlinear. Longitudinal vortices, generating secondary flows along the river-channel/flood-plain interface were found to be important for depths as low as 0.25 relative to depth of flow in the main channel. The upwelling at the river-channel/flood-plain interface causes considerable variations in horizontal mean velocities and Reynolds stresses, which in turn produce large plan-form eddies that transfer momentum from the river channel to the flood plain. The lateral variations in local friction factor for different relative depths suggest that, unlike the depth-averaged eddy viscosity, constant values may be ascribed to particular subareas of a compound channel. (Author's abstract)
W91-00039

SERC FLOOD CHANNEL FACILITY: SKEWED FLOW EXPERIMENTS.
Bristol Univ. (England). Dept. of Civil Engineering.
S. C. Elliott, and R. H. Sellin.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 2, p 197-214, 1990.

Descriptors: *Hydraulic models, *Hydraulics, *Open-channel flow, *Velocity distribution, Boundary processes, Flood plains, Flow measurement, Momentum equation, Shear stress, Water circulation.

Experiments carried out on a skewed compound channel in the Science and Engineering Research Council (SERC) Flood-Channel Facility operated at Hydraulics Research Ltd., Wallingford, England, are described. The project is one of a coordinated group of four being run simultaneously by U.K. University research groups involving the hydraulics of overbank river flow. The interactive cross flows that occur between floodplain and main channel when the two are not parallel were examined. The project was designed to prepare the way for a later examination of overbank flow in meandering channels. Results show that the velocity distribution both in the main channel and over the two floodplains are distorted by the cross flow, as is the boundary shear stress distribution. The momentum equation was used to analyze the forces acting on the flow both for the whole cross section and also for the sub-units comprising the floodplains alone. The apparent shear force at the floodplain longitudinal interface was isolated from the momentum transport effects of the cross flow and compared with the comparable term in the prismatic compound channel case. From an analysis of velocity and flow-angle distribution in the main channel it was possible to construct a system of secondary circulation cells in the main channel. For the example given this was found to be complex and asymmetric, as might be expected from the imposed flow conditions. (Stoehr-PTT)
W91-00040

CLASSIFICATION OF UNIDIRECTIONAL THREE-LAYER FLOW OVER A HUMP.
Contra Costa Water District, Concord, CA.
R. A. Denton.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 2, p 215-233, 1990. 6 fig, 3 tab, 18 ref.

Descriptors: *Channel morphology, *Flow characteristics, *Flow models, *Hydraulics, *Stratified flow, Flow measurement, Flow rates, Froude number, Internal waves, Model studies.

The effect of increasing the constriction of steady multilayer flow over a hump and through a side-wall contraction was investigated. Classification diagrams of hump height versus a representative flowrate Froude number are useful for showing the range of flow conditions over which different flow regimes exist and their relationship with each other. Solutions of the three-layer model at a first-mode control suggest that the velocity profile for multilayer flow should always have an approximately two-layer shape where the flow is critical with respect to the first-mode internal wave. These laboratory experiments for three-layer flow and earlier two-layer experiments confirm that inviscid gradually-varying flow models are able to successfully predict the location of hydraulic controls and the interface profiles for most flow regimes. However, further work is needed to fully explain the difference between theory and experiment when the main control at the hump is an approach control. (Stoehr-PTT)
W91-00041

WAVE TYPE FLOW AT ABRUPT DROPS.
Hirosaki Univ. (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 2E.
W91-00042

THREE-DIMENSIONAL ANALYSIS OF PRESSURES ON DAMS.
Sinotech Engineering Consultant, Inc., Taipei (Taiwan).
M. H. Wang, and T. K. Hung.
Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 116, No. 6, p 1290-1304, June 1990. 9 fig, 2 tab, 18 ref. NSF Grant ECE-8414649.

Descriptors: *Dams, *Earthquakes, *Finite difference methods, *Hydrodynamics, *Mathematical models, *Model studies, Hydraulic structures, Reservoirs, Seismic properties.

The calculation of hydrodynamic pressures in a dam/reservoir system has been advanced from an added mass approach to a more complex dam/water interaction. A span-wise variation of nonlinear hydrodynamic pressures on dams during earthquakes was studied using a finite-difference approximation of Euler's equations, coupled with the nonlinear free-surface boundary condition. The pressure distribution was sensitive to both the longitudinal and lateral components of the ground motion. The dynamic effect of reservoir banks would increase with the dam width. The inward motion of a reservoir bank produced higher pressures on one side, while the outward motion of the other bank resulted in a reduction in hydrodynamic pressures. These effects will be smaller when the slope of the bank deviates from the vertical. The combined effect can be effectively obtained when the geometric parameters of a dam/reservoir system, the changes in water surface, and the earthquake force are cast in the equations of motion. In this case, the time-dependent water surface is transformed to the horizontal plane, and the flow field is mapped onto a cubic region, making it convenient to model the complex reservoir geometry and the wavy water surface by the finite-difference method. (Author's abstract)
W91-00057

NONLINEAR HYDRODYNAMIC PRESSURE ON DAMS.
Pittsburgh Univ., PA. Dept. of Civil Engineering.
T. K. Hung, and B. F. Chen.
Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 116, No. 6, p 1372-1391, June 1990. 17 fig, 1 tab, 25 ref. NSF Grant ECE-8414649, Pittsburgh Supercomputing Center Grant PSCA20.

Descriptors: *Dams, *Earthquakes, *Finite difference methods, *Finite element method, *Hydrodynamics, *Mathematical models, California, Concrete dams, Gravity dams, Hydraulic structures, Pine Flat Dam, Reservoirs, Seismic properties, Waves.

The dynamic interaction between nonlinear hydrodynamic pressures and the vibration of a concrete gravity dam was analyzed by coupling Euler's equations with a finite element model of the dam. The Euler equations for compressible flow were solved with the nonlinear free-surface boundary condition, and with a finite element analysis of the dynamic behavior of the concrete gravity dam. The earthquake force components in the horizontal and vertical directions were cast as the forcing functions in the finite difference equations for fluid motion. The results were compared with those associated with a rigid dam motion. The pressure distributions are very sensitive to dam vibration and surface waves. For El Centro ground motion recorded on October 15, 1979, the calculated rise of the water surface on Pine Flat Dam on King River near Fresno, CA was 8 ft (2.7 m), indicating a strong nonlinear effect on hydrodynamic pressures and the potential hazards of surface waves in the reservoir. The hydrodynamic effect was highly augmented by the vibration of the dam. (Author's abstract)
W91-00058

AIR ENTRAINMENT BY SPILLWAY AERATORS.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
P. Rutschmann, and W. H. Hager.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 765-782, June 1990. 13 fig, 1 tab, 20 fig.

Descriptors: *Aerators, *Air entrainment, *Cavitation, *Model studies, *Spillways, Hydraulic models, Hydrodynamics, Mathematical models.

Aerators on spillways may be regarded as an effective protection against cavitational erosion. The air entrainment of aerators is governed by a number of independent parameters that include the slopes of the spillway and the aerator, the heights of ramp and offset, the approaching flow depth and Froude number, and the stagnation pressure in the nappe cavity. Based upon model observations, two approaches were used to determine the air entrainment coefficient. The direct approach is based upon the analysis of each effect on the coefficient. An expression is presented that should be tested for other geometries. The indirect approach is based on the length of jet for zero cavity subpressure. The resulting expression for the maximum air entrainment coefficient may then be corrected for the effect of cavity subpressure. The present approach introduces developing and developed aerator flow conditions. Further, the cavity subpressure is accounted for by a different Euler number. The final system of equations for the coefficient was compared to model and prototype data, and a fair agreement was noted. (Author's abstract)
W91-00061

BED FORM RESISTANCES IN OPEN CHANNEL FLOWS.
California Univ., Berkeley. Dept. of Civil Engineering.
H. W. Shen, H. E. Fehlman, and C. Mendoza.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 116, No. 6, p 799-815, June 1990. 8 fig, 2 tab, 21 ref. NSF Grant No. ENG-7825054.

Descriptors: *Bed load, *Channel morphology, *Flow around objects, *Flow resistance, *Open-channel flow, *Sediment transport, *Sedimentation, *Streambeds, Darcy-Weisbach equation, Flow friction, Mathematical models, Model studies, Streamflow, Turbulent flow.

The different bed forms that develop at the interface between flow and the river bed are characterized by form resistance that can cause significant rises in flood levels. Many previous studies suggest the division of total resistance into skin resistance and form resistance without direct evidence. The skin resistance, form resistance, and total resistance were independently measured for a series of rigid bed forms in the laboratory. The data show that the sums of skin resistance and form resistance are close to the total resistance for all experimental runs conducted. Furthermore, data collected in this and other studies indicate that form resistance can be predicted from known bed form shapes. The Darcy-Weisbach form factor and the pressure drag coefficients are related only to the relative height of the dunes and independent of the flow velocities. The variation of form resistance for alluvial bed forms are similar to the expansion losses in pipelines. Skin resistance on the bed form has no significant effect on form resistance of the same bed form. The measured local skin stress increases almost linearly from a zero value at the flow reattachment point to a maximum value at the dune crest. A relationship was derived to predict the skin resistance as a function of flow Reynolds number, relative roughness, and relative height of dunes based on data collected in this and other studies. (Author's abstract)
W91-00063

ENERGY HEAD IMPLICATIONS OF THE INSTALLATION OF CIRCULAR FLAP GATES ON DRAINAGE OUTFALLS.
Liverpool Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W91-00068

COMPREHENSIVE GENERALIZED STUDY OF SCOUR AT CANTILEVERED PIPE OUTLETS.
Agricultural Research Service, Stillwater, OK. Water Conservation Structures Lab.
F. W. Blaisdell, and C. L. Anderson.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 4, p 357-376, 1988. 9 fig, 34 ref.

Descriptors: *Conveyance structures, *Erosion, *Hydraulic models, *Mathematical models, *Model studies, *Pipes, *Scour, *Spillways, Sediment transport.

Pipe spillways with cantilevered outlets have been used by the Soil Conservation Service on many of the principal spillways for several million relatively small farm ponds and several ten thousand relatively large upstream floodwater protection and water conservation structures. A literature review revealed information on the general principles of local scour at pipe exits, but inadequate practical information on scour and prevention of scour at pipe outlets. A study addressed the design of riprapped cantilevered pipe spillway plunge pool energy dissipators having the shape of self-formed scour pools. The design of the experiment was based upon the assumption that the cantilevered pipe will be a satisfactory spillway outlet structure for a range of discharges and bed material sizes, but that excessive scour will occur if the flow rate exceeds some limit. The study variables and their range were selected to cover the range of anticipated practical use. Discharge rate, pipe slope, water temperature, and a variety of bedload materials were used in the experiments. The flow was interrupted periodically during the test runs and the scour hole measured to record the time development of the scour. It was determined that the scour hole shape varies with the discharge, length of time of scour, and whether or not material is suspended in the scour hole. 'Beaching' occurs when the strength of the reverse currents along the sides of the scour hole are sufficient to erode the bank material. Equations for the jet trajectory were developed to determine the theoretical path from the pipe exit to the point at which the jet attacks the bed. (Tappert-PTT)
W91-00072

PREDICTION OF FLOW CHARACTERISTICS IN MAIN CHANNEL/FLOOD PLAIN FLOWS.
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. J. Keller, and W. Rodi.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 4, p 425-441, 1988. 7 fig, 2 tab, 26 ref.

Descriptors: *Channel flow, *Channels, *Flood channels, *Flumes, *Mathematical models, *Model studies, *Streamflow, Finite volume method, Flow models.

Flow in channels of compound cross-section, comprising a deep main channel and adjacent shallow flood plains, is a complex, three-dimensional phenomenon. The development of a depth-averaged two-dimensional mathematical model to calculate flow characteristics in channels of compound cross-section simplifies the calculations for instances where the resolution of vertical distributions is not of interest. The model utilizes a previously developed depth-averaged form of the kappa-epsilon turbulence model. The solution procedure is a finite volume method and is particularly economical with regard to both computing time and storage requirements. The model was tested against velocity and bed shear stress data taken from the literature and obtained in laboratory flumes modelling a main channel/flood plain geometry. Comparisons between these data and model predictions show generally good agreement. One necessary input to the model is the dimensionless transverse eddy diffusivity, e, which has a significant influence on the predicted distributions. A value of 0.15, adopted from the literature for rectangular laboratory flumes, was shown to be appropriate for laboratory compound channels. However, application of the model to natural compound channels requires further investigation of this parameter. (Tappert-PTT)
W91-00073

CONVERSION OF BRAIDED GRAVEL-BED RIVERS TO SINGLE-THREAD CHANNELS OF EQUIVALENT TRANSPORT CAPACITY.
Canterbury Regional Council, Christchurch (New Zealand).
For primary bibliographic entry see Field 2J.
W91-00078

HYDROLOGIC AND HYDRAULIC RESEARCH IN MOUNTAIN RIVERS.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2E.
W91-00083

PREDICTION OF ENTRAINMENT CONDITIONS FOR NONUNIFORM, NONCOHESIVE SEDIMENTS.
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W91-00094

DESIGN OF SETTLING BASINS.
Indira Gandhi National Open Univ., New Delhi (India).
For primary bibliographic entry see Field 2J.
W91-00097

BRIDGES AND CULVERTS REDUCED IN SIZE AND COST BY USE OF CRITICAL FLOW TRANSITIONS.
Shire of Stawell (Australia).
N. H. Cottman, and G. R. McKay.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 88, No. Pt 1, p 421-437, June 1990. 12 fig, 1 tab, 6 ref.

Descriptors: *Bridge design, *Bridges, *Culverts, *Hydraulic engineering, Channel design, Construction costs, Flood plain management, Streamflow.

A means for reducing the size and cost of bridges and culverts was explored to increase throat velocity by streamlining the whole of the upstream approach and downstream exit flows at structures, rather than increasing the head. This innovative concept for designing channel transitions converged wide, shallow, subcritical flows into high-velocity critical flows. The flows were then passed through deep, narrow throats that were cheaply culverted or bridged. The outflow was finally diverged, spread and decelerated before being passed downstream with minimum head losses. These minimum energy or maximum discharge designs were first used in Australia in 1961. They offered a means of passing large flows through much smaller, more efficient and more economical culverts and bridges, without the considerable upstream afflux that is the bane of conventional hydraulic structures. The design procedures accurately predicted performances in the field. The usual problems of erosion, siltation, debris and energy dissipation were shown to be either absent or manageable. The concept was very useful for increasing the capacity of many suitable flood plain bridges at minimal cost. (Mertz-PTT)
W91-00100

VARIATIONAL PRINCIPLE METHOD WITH VARIABLE DOMAIN IN THE FLOW PROBLEM WITH FREE SURFACE.
Shanghai Inst. of Mechanical Engineering (China).
C. Yue-Lin, and Y. Xiao-Fing.
Advances in Water Resources AWREDI, Vol. 13, No. 1, p 50-52, March 1990. 5 fig, 5 ref.

Descriptors: *Finite element method, *Fluid mechanics, *Free surfaces, *Mathematical models, Data interpretation, Gravity dams, Gravity flow, Hydraulic models, Mathematical analysis.

The finite element method has been used to solve hydraulic problems since the early 1970s. An important factor of the method is how to deal with the free surface problem when the exact position of the free surface is not known beforehand. A variational principle with variable domain is used in the solution. The method introduces a functional on the variable domain, then obtains a solution equal to that of differential equations by directly solving the extreme value of the functional. When

conventional finite element analysis is undertaken, the domain (D) is divided in two domains, D1 and D2, where D1 is a presumed fixed domain and D2 is a variable domain. The method can be used to calculate dam outflow. (Tappert-PTT)
W91-00122

SIPHON QUENCHES.
Ketchikan Pulp Co., AK.
For primary bibliographic entry see Field 8A.
W91-00142

EXPLICIT METHODS FOR 2-D TRANSIENT FREE-SURFACE FLOWS.
Florida International Univ., Miami. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W91-00151

VORTEX DROP INLET FOR SUPERCRITICAL APPROACHING FLOW.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 8A.
W91-00153

DESIGN OF STABLE ALLUVIAL CHANNELS.
Kuwait Inst. for Scientific Research, Safat. Hydraulics and Coastal Engineering Group.
For primary bibliographic entry see Field 2J.
W91-00154

SINGLE-OUTLET DETENTION-POND ANALYSIS AND DESIGN.
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W91-00171

MODEL OF FLOW IN REGULATED OPEN-CHANNEL NETWORKS.
Miami Univ., Coral Gables, FL. Coll. of Engineering.
For primary bibliographic entry see Field 2E.
W91-00172

CATASTROPHE MODEL FOR THE FORCED HYDRAULIC JUMP.
Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ingenieria.
P. M. Austria.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 269-280, 1987. 11 fig, 1 tab, 13 ref.

Descriptors: *Catastrophe theory, *Hydraulic jump, *Hydraulic models, *Hydraulics, *Mathematical models, *Model studies, *Open-channel flow, Mathematical analysis, Mathematical equations.

In open channel flow, when a hydraulic jump is forced, an hysteretic behavior is observed in a particular range of values of the governing variables. The catastrophe theory was applied to the study of this phenomenon. The geometry of the cusp catastrophe was used as a descriptive model with which it was possible to gather certain behavior peculiarities in the phenomenon, such as hysteresis, sudden jumps, bimodality, and divergence. In addition, a nomenclature in accordance with the usual one in catastrophe theory has been proposed. The cusp catastrophe geometry has been used mainly as a descriptive model, the quantitative solution procedure consists essentially in applying well-known equations such as the specific energy equation, with the aid of the qualitative model, and considering the control parameter variation. The results were experimentally verified for a simplified study case, thus work showing how the elementary catastrophe theory can be used as a useful descriptive modeling tool in hydraulics. (Author's abstract)
W91-00373

LOCATING AND IDENTIFYING HYDRAULIC CONTROLS FOR LAYERED FLOW OVER AN OBSTRUCTION.
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W91-00374

STATE SPACE APPROACH TO THE BEHAVIOR OF SEWER SYSTEMS.
Barcelona City Dept. of Public Works (Spain). Planning Div.
For primary bibliographic entry see Field 5D.
W91-00375

INVISCID DAM-BREAK SOLUTION.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 3, p 313-327, 1987. 11 fig, 13 ref.

Descriptors: *Channel flow, *Dam failure, *Hydraulic models, *Hydraulics, Dams, Mathematical analysis, Mathematical equations, Mathematical models, Model studies, St Venant equation.

A solution has been calculated and plotted dimensionlessly for a dam-break flood on a sloping channel that is initially dry. The solution neglects channel bed resistance and assumes that the entire dam is removed instantaneously. In obtaining this solution, it has been shown that a solution for a dry channel does not exist when the usual approximations are made for a non-zero bed-resistance term in the St. Venant equations. Comparisons of the inviscid solution with experimental measurements for two different channel roughnesses showed that increasing the channel roughness caused large increases in both flow depths and wetting-front arrival times. Since increasing the scale of an experiment often causes a decrease in relative roughness and an increase in Reynolds numbers, it is concluded that prototype measurements relatively close to the burst dam may well be approximated more closely with the inviscid solution calculated herein than with experimental measurements obtained from a small-scale model. (Author's abstract)
W91-00376

TRANSIENT ANALYSIS OF WATER DISTRIBUTION SYSTEMS.
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-00379

FORCED AERATION OF HIGH VELOCITY FLOWS.
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
For primary bibliographic entry see Field 8A.
W91-00396

LOCAL SCOUR AROUND BRIDGE PIERS.
Nanyang Technological Inst., Singapore.
For primary bibliographic entry see Field 2J.
W91-00397

MODIFIED ELEMENT METHOD FOR PIPE NETWORK ANALYSIS.
Laval Univ., Quebec. Dept. of Civil Engineering.
P. Dupuis, J. L. Robert, and Y. Ouellet.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 1, p 27-40, 1987. 4 fig, 1 tab, 19 ref.

Descriptors: *Hydraulic systems, *Network analysis, *Pipe flow, *Pipes, Approximation method, Computer models, Element method, Mathematical analysis.

As a result of the recent boom in microcomputer hardware, the element method for pipe network analysis has become feasible for determining flow and pressure in hydraulic networks. The proposed modified method addresses the convergence behavior by using a Newton-Raphson procedure on the residue of a partionned matrix system. Reordering of the elements gives a sub-matrix topology of particular types that can be inverted with efficient algorithms. It results in a matrix, the order of which corresponds to the number of loops in the system, to be inverted during the iterative process. Two examples, taken from previous papers, illustrate the advantages of the method: a gain in convergence compared to classical methods, a resolution strategy optimized by the improvement of the matrix topology and its partitioning into a linear and non-linear submatrix, and good convergence behavior for bad cases and use of the self-adjusting friction factor. (MacKeen-PTT)
W91-00398

STEADY UNIFORM FLOW IN PRISMATIC CHANNELS WITH FLOOD PLAINS.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-00761

DISCHARGE CHARACTERISTICS OF LOCAL DISCONTINUOUS CONTRACTIONS, II.
Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
W. H. Hager.
Journal of Hydraulic Research JHYRAF, Vol. 25, No. 2, p 197-213, 1987. 14 fig, 9 ref, append.

Descriptors: *Channels, *Discharge hydrographs, *Flow, *Flow characteristics, *Hydraulic models, *Open-channel flow, *Submerged flow, Flow pattern, Head loss, Theoretical analysis.

Discharge characteristics of a local, discontinuous contraction in a rectangular channel for submerged flow conditions were studied using a theoretical approach analyzing the separation zone as well as the local head-loss along the contraction by accounting for the contraction ratio, the inlet angle and the relative contraction length. General solutions are obtained by a matching procedure, and design relations are established. It was found that the separation of the flow from the leading edges of the contraction geometry and the local head-loss for zones of diverging streamlines must be accounted for. Based on a quasi two-dimensional approach, these two quantities are theoretically investigated for two limit cases. The general solution for arbitrary contraction geometry and subcritical flow characteristics is found by a matching procedure. The final result allows direct application to arbitrary cases. The possible flow pattern in connection with local contractions can be classified into a transitional, a purely subcritical and a locally supercritical flow state with surface undulations. Experiments were performed in order to verify the theoretical approach, and a good agreement was found. The deviations with respect to the upstream flow depth were always below 30%. (Agostine-PTT)
W91-00762

8C. Hydraulic Machinery

ENERGY HEAD IMPLICATIONS OF THE INSTALLATION OF CIRCULAR FLAP GATES ON DRAINAGE OUTFALLS.
Liverpool Univ. (England). Dept. of Civil Engineering.
R. Burrows, and J. Emmonds.
Journal of Hydraulic Research JHYRAF, Vol. 26, No. 2, p 131-142, 1988. 6 fig, 12 ref.

Descriptors: *Flap gates, *Gates, *Head loss, *Hydraulic gates, *Hydraulic machinery, *Hydraulic structures, *Sewer systems, Flooding, Hydraulics, Hydrodynamics, Outfall sewers, Urban areas.

Flap gates are widely used for the protection of drainage systems against flood influx from high receiving stream levels or from tidal levels in coastal locations. Inclusion of a gate will increase the consequential upstream surcharge or flooding, especially for closed conduit systems such as urban sewers where little detention storage capacity is available for temporary retention of the storm

influx. Experimental apparatus was constructed to establish what additional upstream head results from the use of flap gates. The effect of gate weight, gate angle, flow rate, and other construction parameters was investigated. Energy losses resulting from the flow constriction are found to be largely dependent on the flowrate and the gate's weight when subjected to a tailwater surcharge. Guidance on gate selection and head loss implications in the literature is sparse and design curves are presented to partially fill this gap. These curves show that the total energy loss at the outfall resulting from the use of heavy gates can be more than double the kinetic energy head of the pipe flow, representing the normal pipe exit losses. Protection of the outfall by means of a wing-wall surround with raised sill may further increase the head requirement. (Tappert-PTT)
W91-00068

ANALYSIS OF SCALE EFFECTS ON PERFORMANCE CHARACTERISTICS OF HYDRAULIC TURBINES: PART 2: EFFECTS OF SURFACE ROUGHNESS, RUNNER SEAL CLEARANCE AND REYNOLDS NUMBER ON PERFORMANCE AND LOSS DISTRIBUTION COEFFICIENTS.
Kanagawa Univ. (Japan). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 8G.
W91-00098

8D. Soil Mechanics

THREE-DIMENSIONAL BOUNDARY ELEMENT RESERVOIR MODEL FOR SEISMIC ANALYSIS OF ARCH AND GRAVITY DAMS.
National Research Council of Canada, Ottawa (Ontario). Inst. for Research in Construction.
A. M. Jablonski, and J. L. Humar.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 19, No. 3, p 359-376, April 1990. 12 fig, 27 ref.

Descriptors: *Arch dams, *Boundary element method, *Gravity dams, *Mathematical models, *Model studies, *Seismic properties, Dam foundations, Data interpretation, Mathematical analysis, Reservoirs.

The seismic analysis and design of an arch dam has not been studied in as much detail as that of a concrete gravity dam because of the complex nature of the problem. The boundary element method has been successfully applied in the past to the analysis of hydrodynamic forces in two-dimensional infinite as well as two-dimensional and three-dimensional finite reservoirs subjected to seismic ground motion. More recent research on the application of the constant boundary element method (BEM) to the 3D analysis of reservoir vibration demonstrate the effectiveness of the procedure for evaluating hydrodynamic pressures in a 3D water reservoir of arbitrary shape. The energy loss in the waves traveling to infinity is represented by a special boundary condition to be applied to the truncated far end of the reservoir. Special boundary conditions, previously used in the 2D case to treat infinite radiation damping and damping from foundation soil and banks, have been incorporated in this formulation. Numerical results for vibration of a 3D infinite rectangular reservoir as well as of a 3D infinite reservoir impounded by an arch dam are presented and compared with some existing results obtained by other researcher. Most of the results show qualitative similarities, although significant differences exist presumably due to the difference in the geometry of the infinite part. One drawback of the BEM is the frequency dependence of the fundamental solution which requires the computation of the elements of boundary element matrices for each excitation frequency. (Tappert-PTT)
W91-00123

8E. Rock Mechanics and Geology

GEOLOGIC AND HYDROLOGIC ISSUES RELATED TO SITING A REPOSITORY FOR HIGH-LEVEL NUCLEAR WASTE AT YUCCA MOUNTAIN, NEVADA, U.S.A.
Department of Energy, Carson City, NV. Nevada Nuclear Waste Project Office.
For primary bibliographic entry see Field 5E.
W91-00030

SHAKE TABLE TEST OF CYLINDRICAL WATER TANKS IN BASE-ISOLATED STRUCTURES.
Parsons (Ralph M.) Co., Pasadena, CA.
M. S. Chalhoub, and J. M. Kelly.
Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 116, No. 7, p 1451-1472, July 1990. 24 fig, 1 tab, 10 ref, append.

Descriptors: *Earthquake engineering, *Hydrodynamics, *Isolation, *Structural behavior, *Water tanks, Buildings, Kinematic wave theory, Structural engineering, Waves.

Extensive work has been done on the response of internal equipment in structures subjected to ground motion. An important advantage of base isolation is the protection of internal equipment, including fluid containers, in buildings against high accelerations transmitted from the ground and amplified in the structure. The dynamic pressure exerted by the fluid on the walls of its container greatly depends on the support acceleration. Base isolation reduces drastically the amplification of these accelerations. The low frequency that characterizes the motion of base isolated structures can affect the water elevation response. The response of a cylindrical water tank fixed to the shake table was compared to that of a similar one installed in the bottom of a base-isolated nine-story steel structure. The structure was isolated on eight multilayered elastomeric bearings. Due to the reduction in ground accelerations, the dynamic pressure is reduced for the tank in the isolated structure. Free-surface water elevation was slightly increased due to the lower frequency that characterizes the motion of base-isolated structures. This problem can by overcome by appropriate selection of the isolation system or by the addition of dampers at the location of maximum water particle velocities. The response of fixed base structures is amplified along their height, while for base-isolated structures, the base and higher stories have practically the same response. For this reason, when fluid containers are located in the upper stories of a building, base isolation is very favorable. A theoretical solution developed from linear wave theory correlates very well with the experimental results. (Fish-PTT)
W91-00147

HYDROGEOLOGY OF THE DINARIC KARST.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 2F.
W91-00318

GEOLOGY OF KARST TERRAINS AND THEORY IN THE WORKS OF JOVAN CVIJIC.
Institute of Hydrogeological and Geotechnical Research, Belgrade (Yugoslavia).
B. F. Mijatovic, and M. Komatina.
IN: Hydrogeology of the Dinaric Karst. International Contributions to Hydrogeology, Volume 4. International Association of Hydrogeologists. Verlag Heinz Heise GmbH, Hannover, West Germany. 1985. p 9-16, 2 fig, 9 ref.

Descriptors: *Aquifer systems, *Aquifers, *Geohydrology, *Karst, *Karst hydrology, *Regional Aquifer-Systems Analysis, *Yugoslavia, Erosion, Geologic history, Geology, Groundwater, Hydrography, Theoretical analysis.

The research of Jovan Cvijic in the field of karst phenomena is discussed. Cvijic published his observations on geologic, geomorphologic and hydrographic conditions of individual karst terrains and karst in general, in a number of books in the early 20th century. His contribution to the understanding of the Central Dinaric Karst, and in particular its main phenomena, the karst poljes, is in his interpretation of poljes' origin, evolution and hydrographic features. According to Cvijic, the poljes are erosion forms but their tectonic predisposition is often highly expressed. The target points of the erosion are often connected to marginal and other faults. Cvijic's postulatiens concern three hydrographic zones in karst: the dry zone, the transition zone, and the zone with permanent water flows. The need for proper understanding of field geology for the detection and capture of waters of karst aquifers is stressed. (See also W91-00318) (MacKeen-PTT)
W91-00319

8G. Materials

ANALYSIS OF SCALE EFFECTS ON PERFORMANCE CHARACTERISTICS OF HYDRAULIC TURBINES: PART 2: EFFECTS OF SURFACE ROUGHNESS, RUNNER SEAL CLEARANCE AND REYNOLDS NUMBER ON PERFORMANCE AND LOSS DISTRIBUTION COEFFICIENTS.
Kanagawa Univ. (Japan). Dept. of Mechanical Engineering.
T. Ida.
Journal of Hydraulic Research JHYRAF, Vol. 28, No. 1, p 93-104, 1990. 9 fig, 10 ref.

Descriptors: *Hydraulic turbines, *Hydraulics, *Reynolds number, *Roughness coefficient, *Turbines, Flow rates, Loss distribution coefficient, Surface roughness, Surface velocity, Water temperature.

The effect of surface roughness of flow passages, runner seal clearance and the Reynolds number on the hydraulic performance and loss distribution coefficient was examined. V-(opt), which is the value of the loss distribution coefficient at the optimum efficiency point, varies within the range of approximately 0.96-1.05 times the original value when the surface roughness of all of flow passages in a model turbine becomes 0.5-2 times the original roughness. However, the loss distribution coefficient at the optimum efficiency point does not vary with the runner seal clearance. When the Reynolds number varies with the change of head or water temperature, the admissible surface roughness of each flow passage decreases as the Reynolds number increases, thus each friction coefficient becomes the value corresponding to the rough surface region. As a result, the change of performance and the loss distribution coefficient at the optimum efficiency point due to the change of the Reynolds number becomes smaller in comparison to that in the case with smooth surfaces. On the contrary, when the head, water temperature and surface roughness are unchanged and the Reynolds number varies only with the size of turbine, the relative roughness decreases as the Reynolds number increases and becomes the value in the smooth surface region. As a result, the change of performance and loss distribution coefficient at the optimum efficiency point is larger than the former case mentioned above. In other words, the effect of roughness cannot be neglected for examining the effect of the Reynolds number on the optimum efficiency loss distribution coefficient. (Author's abstract)
W91-00098

SEISMIC DAMAGE TO SEGMENTED BURIED PIPELINES.
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Civil Engineering.
K. Elhmahdi, and M. J. O'Rourke.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 19, No. 4, p 529-539, May 1990. 9 fig, 3 tab, 12 ref.

Descriptors: *Earthquake engineering, *Mathematical models, *Pipelines, *Pipes, *Seismic waves,

*Water conveyance, Leakage, Soil properties, Strain, Water mains.

Segmented buried pipelines are commonly used in water supply, sewage, and gas systems. These pipelines are frequently damaged during earthquakes as a result of permanent ground deformation or seismic wave propagation. This damage most often occurs at the joints. An analytical model for evaluating the response of long straight runs of segmented buried pipelines to seismic wave propagation is presented that takes into account the non-linearity as well as the variability of the system characteristics. Model results indicate that the variability of joint displacement is strongly influenced by a variability in joint stiffness characteristics, but not significantly influenced by variations in soil properties. The probability of leakage is a function of the normalized joint displacement. Results from laboratory tests by others are used to establish the relative joint displacement which leads to leakage. These elements are combined to predict the damage ratio (number of leaks per kilometer) for cast iron pipes with lead caulked joints subject to a joint pull-out failure mode. The joint pull-out damage ratio is a decreasing function of pipe diameter, and for any diameter it is a non-linear function of ground strain. (Tappert-PTT)
W91-00124

HYDROLOGIC PARAMETER EFFECTS ON SMALL-DAM RISK ANALYSIS IN MISSOURI.
Missouri Univ.-Columbia. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W91-00167

RISK OF DEBRIS-BASIN FAILURE.
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W91-00181

HYDROGEOLOGICAL STUDY OF LATERITE AT A REPRESENTATIVE DAM SITE IN MALVAN VALLEY OF KONKAN REGION (MAHARASHTRA-INDIA) USING SEISMIC REFRACTION METHOD.
Central Water and Power Research Station, Poona (India).
For primary bibliographic entry see Field 2F.
W91-00240

TRANSPORT OF LOW-CONCENTRATION CONTAMINANTS IN SATURATED EARTHEN BARRIERS.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W91-00372

SAFETY GOALS FOR HIGH-HAZARD DAMS: ARE DAMS TOO SAFE.
Carnegie-Mellon Univ., Pittsburgh, PA. Graduate School of Industrial Administration.
For primary bibliographic entry see Field 8A.
W91-00587

STAINLESS STEEL IN WASTEWATER TREATMENT PLANTS.
Tuthill Associates, Blacksburg, VA.
For primary bibliographic entry see Field 5D.
W91-00628

STRIDES IN NONDESTRUCTIVE TESTING.
Olson Wright NDT and E, Inc., Lakewood, CO.
L. D. Olson, C. Wright, and K. H. Stokoe.
Civil Engineering (ASCE) CEWRA9, Vol. 60, No. 5, p 52-55, May 1990. 4 fig.

Descriptors: *Materials testing, *Nondestructive tests, *Seismology, *Spectral analysis, Civil engineering, Dam inspection, Foundations, Materials engineering, Seismic waves, Shear stress, Stability analysis, Stress analysis, Youngs modulus.

Stress wave methods of materials testing are finding increasing applications in the civil engineering field. Mechanically generated stress waves involve one of four measurements approaches (1) frequency or spectral analysis of surface wave propagation; (2) direct measurement of stress wave velocities; (3) measurement of stress wave echoes; and (4) resonant, or modal vibration measurements. A new seismic method, spectral analysis of surface waves (SASW) determines shear modulus profiles at soil sites and Young's modulus profiles at pavement sites. SASW was used to determine the global density of a massive landslide in the Valtellina valley of northern Italy in 1987. The SASW measurements were effective to depths of more than 150 ft without drilling borings. Two primary low-strain stress wave techniques for evaluating the integrity and length of deep foundations from the foundation head are seismic echo (SE) and impulse response (IR). The two surface methods were used on a drilled shaft foundation for a microwave communication tower for which the New Jersey Transit Authority specified quality assurance with respect to deep foundation integrity. The two methods gave comparable results and the IR test also measured the low-strain dynamic stiffness (force-deflection) at the foundation head. The IR method was adapted for subgrade support evaluation of concrete slabs and pavements and can be used to evaluate spillways, conduits, tunnels, and grouting. The adapted IR method detected loss of subgrade support in the foundation of a warehouse damaged by water. Two main stress wave techniques are used to evaluate structural integrity: ultrasonic pulse velocity (a direct measurement technique) and impact echo (IE). IE is a sonic echo test for detecting flaws and measuring thicknesses of structural concrete members. IE methods detected cracks in Humphrey's Dam, an arch dam in southwest Colorado. (Geiger-PTT)
W91-00676

CASE HISTORIES OF SULFIDE CORROSION: PROBLEMS AND TREATMENTS.
Brown and Caldwell, Sacramento, CA.
R. A. Witzgall, I. S. Horner, and P. L. Schafer.
Water Environment & Technology WAETEJ, Vol. 2, No. 7, p 42-47, July 1990. 2 tab, 3 ref.

Descriptors: *Corrosion, *Sulfides, *Wastewater facilities, *Wastewater treatment, Biochemical oxygen demand, Case studies, Dissolved oxygen, Environmental effects, Model studies, Odor control, Oxygen uptake, Sulfates, Suspended solids, Temperature, pH.

Five wastewater systems that experienced sulfide corrosion problems were studied. The projects selected spanned the U.S., with one project in Lakeland, Fla., and two projects each in Omaha, Neb., and Sacramento, Calif. Four of the five case studies were based on projects undertaken to investigate existing sulfide corrosion and odor problems. Each of these projects required extensive data collection and field investigation to characterize the wastewater and environmental conditions and to determine the extent of corrosion problems. The following wastewater parameters were of interest: biochemical oxygen demand (BOD) and soluble BOD, temperature, sulfate concentration, pH, dissolved oxygen (DO), oxygen uptake rate, total suspended solids, oxidation-reduction potential, and total and dissolved sulfide. In addition, hydrogen sulfide gas in the sewer atmosphere was of primary interest. In each of these five studies, sulfide and corrosion modeling was conducted to evaluate future conditions and to determine the accuracy of the models and why corrosion was occurring. In a comparison of the models with actual data, the sulfide model predicted with 50% accuracy. Making correlations on the corrosion model was more difficult because few wastewater agencies have the history of sulfide data required to make the comparison. The case studies indicated a general level of agreement with the corrosion model, certainly better than an order of magnitude. In general, municipalities have not prepared sufficiently detailed information on their successes and failures in sulfide and corrosion contr l to allow others to benefit. (Agostine-PTT)
W91-00768

8I. Fisheries Engineering

IMPROVING THE EFFECTIVENESS OF FISHERIES AGENCIES IN DEVELOPING HYDROPOWER MITIGATION.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 6E.
W91-00008

SEASONAL HABITAT USE BY WALLEYE IN A WARMWATER RIVER SYSTEM, AS DETERMINED BY RADIOTELEMETRY.
Iowa Dept. of Natural Resources, Manchester. Northeast District Headquarters.
V. L. Paragamian.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 4, p 392-401, Fall 1989. 6 fig, 2 tab, 18 ref. Federal Aid in Fish Restoration, project F-115-R.

Descriptors: *Aquatic habitats, *Fish behavior, *Iowa, *Spawning, *Stream fisheries, *Walleyes, Ceder River, Dams, Ecosystems, Seasonal distribution, Tailwater, Telemetry, Water currents, Water temperature.

Thirty-one adult walleyes, Stizostedion vitreum, were implanted with radio transmitters and tracked in the main-stem Ceder River, Iowa, and two of its tributaries from September 1986 through July 1988. The objectives were to identify specific habitat use by walleyes at various times of the year, to determine interstream movement patterns, and to identify walleye spawning sites. Fish with transmitters were located 363 times, and 92% of fish locations were within 9.7 km of a dam on the Ceder River. Walleyes preferred gravel-cobble substrates during autumn and were often in water 1.25-1.8 m deep. Overhead cover was not essential. When decreasing water temperature approached 5 C, most fish overwintered in pools 1.5-3.0 m deep. Activity of walleyes increased as spring water temperatures rose to about 2.8 C, the approximate temperature at which most walleyes moved upstream. Actual spawning took place at about 11 C and occurred in a ruffle (the tailwater of a dam) comprising large cobble and small boulders in a current of 1.4-1.5 m/s. Walleyes drifted downstream after spawning to pools 1.2-1.8 m deep and were sedentary for about 2 weeks. Several female walleyes died soon after the spawning season. During summer, walleyes preferred gravel-cobble substrates, used a variety of depths, and were near current breaks and upstream edges of pools. When summer temperatures reached 30 C, some walleyes sought deep pools. Exploitation of walleyes within the first year of the study would have been 54% if most fish had not been released by anglers. This indicated that: (1) adult walleyes preferred moderate current with cobble-gravel substrates most of the times of the year; (2) spawning occurred nearly exclusively in the tailwater of a dam; (3) walleyes were concentrated and spawned within a very short time span; (4) preferred walleye habitat is nearly nonexistent in many portions of the Ceder River system; and (5) impoundments accumulate sediment and thereby reduce walleye habitat upstream but protect habitat downstream. (Author's abstract)
W91-00009

EFFECTS OF A FIXED-CREST WEIR ON BROWN SHRIMP PENAEUS AZTECUS GROWTH, MORTALITY, AND EMIGRATION IN A LOUISIANA COASTAL MARSH.
Louisiana State Univ., Baton Rouge. School of Forestry and Wildlife Management.
E. E. Knudsen, R. F. Paille, B. D. Rodgers, and W. H. Herke.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 4, p 411-419, Fall 1989. 4 fig, 3 tab, 31 ref.

Descriptors: *Coastal marshes, *Dam effects, *Ecological effects, *Estuaries, *Shrimp, *Water resources development, *Weirs, Animal behavior, Growth, Louisiana, Migration, Mortality.

The effects of water-control weirs on growth, emigration, and mortality of brown shrimp were investigated. Juvenile shrimp were captured, marked, and released in two shallow-water marsh ponds. One pond had a weir at its only exit. All surviving marked shrimp were recaptured as they emigrated from each pond. Shrimp remained in the weired pond 12-18 d longer after marking than in the unweired pond. Growth of brown shrimp was best described by quadratic functions and was significantly faster in the weired pond than in the unweired one although differences in growth may have been confounded by delayed emigration from the weired pond. Estimated monthly instantaneous mortality of juvenile shrimp, from marking to recapture, ranged from 0.550 to 1.582 in the weired pond, and 0.877 to 1.270 in the unweired pond and apparently varied between the years. Even though brown shrimp remained in the weired pond longer, peaks in emigrating from both ponds coincided with new and full moons. Mean total lengths of marked shrimp at emigration ranged from 83 to 106 mm for the weired pond, and from 66 to 84 mm for the unweired pond. Size of shrimp at emigration and time of emigration varied between years. Although shrimp emigrating from the weired pond were larger than those from the unweired pond, probably due to faster growth and delayed emigration, conclusions from concurrent research were that total biomass of brown shrimp emigrating from the unweired pond was more than double the biomass from the weired pond. (Author's abstract)
W91-00010

EVALUATION OF TROUT PASSAGE THROUGH SIX HIGHWAY CULVERTS IN MONTANA.
Montana Cooperative Fishery Research Unit, Bozeman.
D. A. Belford, and W. R. Gould.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 4, p 437-445, Fall 1989. 4 fig, 2 tab, 19 ref. Federal Highway Administration Grant 8093.

Descriptors: *Culverts, *Ecological effects, *Fish passages, *Highway effects, *Stream fisheries, *Trout, Fish behavior, Flow velocity, Highways, Montana, Water velocity.

Combination of water velocity and passage length in highway culverts were evaluated to determine conditions that enabled or prevented the passage of nonanadromous rainbow trout Oncorhynchus mykiss, brown trout Salmo trutta, cutthroat trout O. clarki, and brook trout Salvelinus fontinalis. Fish passage through six culverts 45-93 m long was determined by trapping and electrofishing. Water velocities were measured 5 cm above the bottom (bottom velocity) and at 0.6 of the water depth at intervals between rest sites throughout the lengths of the culverts. Nonlinear regression lines specific to species and state of sexual maturity were fit to the combinations of mean bottom velocity and passage length representing the most strenuous conditions that allowed the upstream passage of trout. Because of the similarity of the strenuous passage relations among species, the spawning rainbow trout relation could be used as the general criterion for passage of the trout studied. This relation indicated that fish could swim distances of 10, 30, 50, 70, and 90 m with mean bottom velocities up to 0.96, 0.80, 0.74, 0.70, and 0.67 m/s, respectively. (Author's abstract)
W91-00012

STREAM CANOPY AND ITS RELATIONSHIP TO SALMONID BIOMASS IN THE INTERMOUNTAIN WEST.
Forest Service, Ogden, UT. Intermountain Research Station.
W. S. Platts, and R. L. Nelson.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 4, p 446-457, Fall 1989. 3 fig, 4 tab, 29 ref.

Descriptors: *Biomass, *Canopy, *Fish populations, *Riparian vegetation, *Salmon, *Stream fisheries, *Trout, Fish behavior, Grazing, Great Basin, Light intensity, Rocky Mountains, Thermal radiation.

To assess prevailing stream canopy (riparian overstory) conditions on representative streams in the northern Rocky Mountains, and the Great Basin of the western USA, several riparian habitats, including canopy density, light intensity, unobstructed sun arc, and average potential daily thermal input were measured in grazed and ungrazed (rested) portions of each stream. It was also determined to what extent, if any, these habitat components were correlated with salmonid biomass and whether either they or salmonids differed significantly between geographic regions or between grazed or rested pastures. Unobstructed sun arc was significantly and positively correlated with thermal input, and it was the best overall predictor of salmonid biomass per unit volume. Thermal input was a better predictor of salmonid biomass per unit volume in the Great Basin than in the Rocky Mountains, where the thermal regime may exert more influence on fish populations. Mean estimates of fish biomass per unit volume differed significantly between the Great Basin (55.9 g/cum) and Rocky Mountain (13.1 g/cum) study areas and were better related to stream canopy attributes than biomass estimates based on stream surface area; in the Great Basin study areas, the two types of biomass estimates were only weakly correlated with each other. In the Rocky Mountains, ungrazed sites generally had more canopy cover than grazed sites. In the Great Basin study areas, however, differences in canopy were unimportant and were probably related to local management practices in several cases. (Author's abstract)
W91-00013

TESTING OF HABITAT ASSESSMENT MODELS FOR SMALL TROUT STREAMS IN THE MEDICINE BOW NATIONAL FOREST, WYOMING.
Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie.
S. J. Kozel, and W. A. Hubert.
North American Journal of Fisheries Management NAJMDP, Vol. 9, No. 4, p 458-464, Fall 1989. 5 tab, 7 ref.

Descriptors: *Aquatic habitats, *Medicine Bow National Forest, *Model studies, *Stream fisheries, *Trout, *Wyoming, Fish populations, Reach, Standing stock, Streams.

The applicability of four habitat assessment models to small trout streams in the Medicine Bow National Forest were tested. All models yielded predictions of trout standing stocks or ratings of trout cover that were correlated with measured trout standing stocks; however, the predicted and measured standing stocks were not directly proportional, and not all model variables appeared to contribute to the predictions or ratings derived from the models. Among the habitat variables included in the four models, those most highly correlated with trout standing stocks were width-to-depth ratio, abundance of overhead bank cover, average stream width, and level of late-summer streamflow. It is hypothesized that much of the variation in measured habitat and model predictions among the study reaches was due to natural variation in habitat features associated with stream size and reach gradient. (Sand-PTT)
W91-00014

SALMON STOCKS AND SALMON FISHERIES IN THE BALTIC SEA (ITAMEREN LOHIKANNAT JA LOHENKALASTUS).
Finnish Game and Fisheries Research Inst., Helsinki.
E. Ikonen, and V. Pruuki.
Suomen Kalatalous, Vol. 1990, No. 56, p 27-39, 1990. 6 tab, 47 ref. English summary.

Descriptors: *Fish management, *Fish populations, *Fish stocking, *Salmon, *Stream fisheries, Baltic Sea, Finland, Gulf of Bothnia, Smolt, Spawning.

In recent history, the salmon rivers flowing to the Baltic Sea and Gulf of Bothnia from Finland annually produced about 7 million salmon smolts. Presently, the production is < 0.5 million. The main reason for this decreased smolt production is damming of the salmon rivers. Part of the lost smolt production has been compensated for by releasing 5-6 million artificially reared salmon smolts in the river mouths. Annual salmon catches in the 1920s were 1000 tons in the sea; in the late 1980s they have been about 3500 tons. The interceptive exploitation of salmon in the sea is so effective that naturally reproducing stocks suffer greatly from the lack of spawners. If the fishing effort in the sea were decreased, the total catches would be higher and the natural stocks would survive. The Gulf of Finland annually received about 0.5 million salmon smolts in the beginning of the 1900s. Natural production is now about 15,000 and the releases of artificially reared smolts amount to 0.5 million. Due to the smolt releases the catches have increased from 100 tons in the 1970s to 300 tons. The total catch could be higher if the age of recruitment to the fishery was raised. (Author's abstract)
W91-00015

SALMON OF THE RIVER SIMOJOKI: RESEARCH AND MANAGEMENT (SIMOJOEN LOHI TUTKIMUKSEN JA HOIDON KOHTEENA).
Finnish Game and Fisheries Research Inst., Helsinki.
E. Jutila.
Suomen Kalatalous, Vol. 1990, No. 56, p 40-48, 1990. 2 fig, 1 tab, 21 ref. English summary.

Descriptors: *Finland, *Fish management, *Fish populations, *Fish stocking, *Salmon, *Simojoki River, *Stream fisheries, Baltic Sea, Dredging, Ecological effects, Gulf of Bothnia, Logging, Smolt, Spawning.

The last river within the Finnish borders which retains its original naturally spawning salmon stock is the Simojoki. In the 1870s the annual salmon catch from the river was about 6500 kg but during the 1970s the annual catch decreased from 1300 kg to 400 kg. During the 1980s it has been 50-200 kg. This decrease is due to the dredging of the river bed for timber floating, and overfishing of salmon in the Baltic Sea and the Gulf of Bothnia. According to capture-recapture results, in the late 1970s the annual salmon smolt production was 30,000-60,000, but during the 1980s only 1500-2000. The dredging, mostly performed in the 1950s, seriously reduced reproduction of the salmon stock. Restoration was done after the cessation of log floating, but this compensated for only about half of the damage. Still more restoration is needed in the river. Because of the increased sea fishery there have not been enough spawners to fill areas suitable for salmon fingerlings. The international regulation of the salmon fishery in the Baltic Sea has not succeeded in putting a stop to overfishing. To avoid extinction of the salmon stock in the Simojoki, stocking with parr has begun in the upper part of the river, where no salmon parr are left. Good results have been reached with releases of one-year-old parr. Currently over 60% of the salmon production of the Simojoki originates from stocking. Smolt production in the Simojoki is slightly increasing due to stocking with salmon parr and the national regulation of the sea and river fishery. (Author's abstract)
W91-00016

REINTRODUCTION OF SALMON AND SEA TROUT INTO THE VANTAANJOKI AND KYMIJOKI RIVERS (LOHEN JA MERITAIMENEN PALAUTTTAMINEN VANTAANJOKEEN JA KYMIJOKEEN).
Finnish Game and Fisheries Research Inst., Helsinki.
A. Saura, and J. Mikkola.
Suomen Kalatalous, Vol. 1990, No. 56, p 49-57, 1990. 6 fig, 14 ref. English summary.

Descriptors: *Finland, *Fish management, *Fish populations, *Fish stocking, *Kymijoki River, *Salmon, *Stream fisheries, *Trout, *Vantaanjoki River, Fish ladders, Fish migration, Smolt, Spawning.

The Kymijoki River was once Finland's most important salmon river flowing into the Gulf of Finland. The Vantaanjoki River was once a significant

sea trout river. The original salmonid stocks in both rivers have been destroyed as a result of damming and pollution of the rivers. In the 1970s and 1980s, environmental protection measures aimed at waters, combined with developments in salmon cultivation, provided a solid basis for an attempt at returning salmonids to the Vantaanjoki and Kymijoki rivers. Presently, 100,000 salmon and 60,000 sea trout smolts are released annually in the Vantaanjoki River, and about 300,000 salmon smolts in the Kymijoki River. In addition, salmon and trout parr of different ages have also been released in rapids in both rivers. Smolt releases have resulted in spawning migrations into the river mouths and upstream. The first fish ladders in the Vantaanjoki and Kymijoki rivers are already in use. The catch in the Vantaanjoki River mouth has been, for example, about 300-400 sea trout and 200-300 salmon annually. The river mouth catch represents for trout about 5% and for salmon about 2% of the total annual catch produced by releases in the Vantaanjoki River. The total annual salmon yield from the Langinkoski branch and the mouth of the Kymijoki River was estimated at about 25 tons. Limiting of sea fisheries would increase particular salmon catches in river mouths and upstream. When released in river rapids as 0-year-old fry, trout grow to 10 cm, and salmon to 7 cm on average in the first summer. Both salmon and trout grow to smolt size in 2 years. Regular releases have resulted in many of the experimental rapids in salmon or trout becoming the dominant species. Solely through efficient stocking of fry, the Vantaanjoki River is capable of producing about 50,000 sea trout or salmon smolts annually. The freely flowing (undammed) rapids in the Kymijoki River could produce, correspondingly, at least 100,000 salmon smolts. (Author's abstract)
W91-00017

CULTIVATON AND MANAGEMENT OF LANDLOCKED SALMON AND CHARR IN LAKE SAIMAA (SAIMAAN JARVILOHEN JA NIERIAN VILJELY JA HOITO).
Finnish Game and Fisheries Research Inst., Helsinki.
J. Piironen.
Suomen Kalatalous, Vol. 1990, No. 56, p 66-73, 1990. 1 fig, 3 tab, 22 ref. English summary.

Descriptors: *Char, *Finland, *Fish management, *Fish stocking, *Lake Saimaa, *Lake fisheries, *Salmon, Endangered species, Fish populations.

The presence of fish rarities--the landlocked salmon (Salmo salar m. sebago) and Arctic charr (Salvelinus alpinus)--in the Vuoksi watercourse is the consequence of events which occurred during the last glaciation period. Landlocked salmon have occurred in the whole area of Lake Saimaa, but have reproduced only in the rapids of the rivers Lieksanjoki, Pielisjoki, and Ala-Koitajoki. Arctic charr have also occurred infrequently in many lakes, but the main populations inhabit deep, oligotrophic lakes in the southern rocky belt of Lake Saimaa. Landlocked salmon became an endangered species due to construction in the rivers for hydroelectric power and dredging, which destroyed the spawning areas. Presently, Arctic charr are also very rare, although the reasons for its decrease are not as well known as for the landlocked salmon. The preservation and propagation of both stocks now depend entirely on intensive fish cultivation and stocking, but effective measures must also be found to promote natural reproduction. This article summarizes the history of culture and stocking and describes present practices and problems in the cultivation of landlocked salmon and Arctic charr. Research on the biology and culture of the two species is briefly presented. (Author's abstract)
W91-00018

RESEARCH ON THE FISHERIES OF SMALL LAKES (PIENTEN JARVIEN KALATUTKIMUKSET).
M. Rask, and J. Ruuhijarvi.
Suomen Kalatalous, Vol. 1990, No. 56, p 101-115, 1990. 2 fig, 4 tab, 74 ref. English summary.

Descriptors: *Finland, *Fish management, *Fish populations, *Lake fisheries, *Sport fishing, *Water pollution effects, Acidification, Carp, Crayfish, Eel, Fish stocking, Heavy metals, Mercury, Perch, Pike, Roach, Trout.

The occurrence of fish species in small Finnish lakes may be limited by colonization barriers, temporarily low oxygen concentrations in the water, high acidity or the simple structure of the habitats. The latter can result in the lack of suitable spawning, nursery or feeding sites for fish. The number of species in small lakes is generally low, the most common species being perch, pike, roach, ruffle and burbot. According to Finnish studies, the total fish biomass in small lakes tends to be 20-40 kg/ha, varying between 10 and 100 kg/ha. The highest biomasses of single species, e.g. roach, perch and crucian carp, have been 50 kg/ha. The annual fish production has been estimated to average 5-15 kg/ha. The monetary value of fish yields from small lakes is usually low, with the possible exception of crayfish, but the potential for recreational fishing may be of value. Introductions of valuable species are commonly used to increase the value of fisheries. Stocking with whitefish, bream and eel has been most successful. Introductions of rainbow trout and brown trout of catchable size seems to be a promising means of creating sport fishing waters. The most severe threat to the fisheries of small lakes is environmental degradation. Large scale problems are posed by acidification and the accumulation of mercury and other toxic substances. At the local level, silvicultural and other practices in the catchment areas may cause increasing organic or nutrient loads, which have a deleterious effect on lakes and their fisheries. (Author's abstract)
W91-00019

FISHES OF BULLITT COUNTY, KENTUCKY.
Clemson Univ., SC. Dept. of Biological Sciences.
For primary bibliographic entry see Field 4C.
W91-00108

WATER TEMPERATURE IN A STREAM GRAVEL BED AND IMPLICATIONS FOR SALMONID INCUBATION.
Freshwater Biological Association, Ambleside (England). Windermere Lab.
D. T. Crisp.
Freshwater Biology FWBLAB, Vol. 23, No. 3, p 601-612, June 1990. 5 fig, 3 tab, 14 ref. UK Department of the Environment Contract PECD 7/7/159.

Descriptors: *Aquatic life, *Fish, *Freshwater, *Gravel, *Incubation, *Limnology, *Salmonids, *Streambeds, *Streams, *Water temperature, England, Statistical analysis, Trout.

Water temperatures were recorded at hourly intervals in the gravel of a trout spawning area in a small stony stream at depths of 0-20 cm in 1985-86 and 0-40 cm in 1987. As depth within gravel increased, the size of the daily fluctuations reduced and their time of occurrence was delayed by about 12 min/cm in 1985-86 and about 6 min/cm in 1987. From October to February mean temperatures at 20 cm depth were, on average, 0.5 C higher than those at the gravel surface. This reflected elevated daily minima more than it reflected elevated daily maxima. From March to July daily minima were lower and daily maxima were higher in the stream than in the gravel. Consequences were: (a) an appreciable increase in mean daily range at all depths in the gravel during the summer, (b) higher daily means (by an average of about 0.4 C) in the water than in the gravel in May to August. Some implications for the early development of salmonid fish are that trout eggs incubated at 20 cm depth in gravel will hatch some 10-11 days earlier than eggs incubated at the gravel surface. However, the predicted time of eyeing of the eggs (a point in development at which they become markedly less vulnerable to mechanical shock), and of time of swim-up of the fry, differed very little between gravel depths. Because of lower temperatures at increasing depths within the gravel, deeply buried eggs would probably reach swim-up appreciably later than those from shallowly buried eggs. After hatching, the salmonids can and do move in the gravel. They are therefore potentially capable of moving along temperature gradients within the gravel in order to optimize their rate of development. (Agostine-PTT)
W91-00427

MANIPULATING LAKE COMMUNITY STRUCTURE: WHERE DO WE GO FROM HERE.
York Univ., Toronto (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-00428

PLASMA ELECTROLYTES, GILL ALUMINUM CONTENT, AND GILL MORPHOLOGY OF JUVENILE ATLANTIC SALMON (SALMO SALAR) AND BROOK TROUT (SALVELINUS FONTINALIS) INDIGENOUS TO ACIDIC STREAMS OF NOVA SCOTIA.
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
For primary bibliographic entry see Field 5C.
W91-00616

PATTERNS OF FISH SPAWNING IN HUDSON RIVER TRIBUTARIES: RESPONSE TO AN URBAN GRADIENT.
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
K. E. Limburg, and R. E. Schmidt.
Ecology ECOLAR, Vol. 71, No. 4, p 1238-1245, August 1990. 6 fig, 1 tab, 20 ref. Hudson River Foundation Grant 005/87R/012.

Descriptors: *Alewife, *Anadromous fish, *Estuarine fisheries, *Hudson River, *Spawning, *Urban watersheds, Environmental gradient, Fish, Fish eggs, Regression analysis, Survival, Tributaries.

Two features of many large river watersheds, their large geographic extent and their occupation and use by humans, should render them good candidates for the manifestation of anthropogenic, ecological gradients. This study was conducted to evaluate the contribution of nontidal tributaries to anadromous fish spawning within a large, riverine estuary. The study was conducted in the watershed of the tidal Hudson River, located in eastern New York State, and 16 tributaries were selected, grouped into four geographic areas ('reaches'). A variety of data were collected, including water quality, physiography, stream characteristics, land use and geographic position in the overall watershed. All streams were sampled weekly from mid-March through June 1988, the period bracketing anadromous fish spawning in the mainstem. Multiple regression analyses were used to examine the relationship of total, anadromous, and resident species' spawning and survival in relationship to water quality parameters, physiography, and land use. Dissolved oxygen values were correlated with neither watershed area nor mean depth at the sampling site, but were both spatially and temporally more variable with increasing land under urbanized use. Spawning activity was highly regionalized, with the vast majority of eggs and larvae collected in three streams in one reach. A total of 23 species was collected, but alewife (Alosa pseudoharengus), composed 93% of the catch. The strongest and most consistent relationship was between densities of eggs and larvae and the index of urbanization, with the data demonstrating a strong threshold effect of urbanization on anadromous spawning success. Salt front location in the Hudson mainstem was not significantly correlated with spawning. The proximal causes of spawning variability result, at least in part, from some aspects of urbanization. (VerNooy-PTT)
W91-00617

RESPONSE OF A BROOK TROUT (SALVELINUS FONTINALIS) POPULATION TO A REDUCTION IN STREAM BENTHOS FOLLOWING AN INSECTICIDE TREATMENT.
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
For primary bibliographic entry see Field 5C.
W91-00660

PREDICTING SUCCESS OF WALLEYE STOCKING PROGRAMS IN THE UNITED STATES AND CANADA.
Idaho Univ., Moscow. Coll. of Forestry.
D. H. Bennett, and T. J. McArthur.
Fisheries (Bethesda) FISHDN, Vol. 15, No. 4, p 19-23, July/August 1990. 3 tab, 14 ref.

Descriptors: *Fish stocking, *Lakes, *Mathematical models, *Reservoirs, *Surveys, *Walleyes, Computers, Lake morphometry, Water quality.

A model was developed to predict the probability of establishing a reproducing population of walleye (Stizostedion vitreum) in lakes and reservoirs in North America. A list of 542 lakes of reservoirs where walleye stocking occurred was obtained by questionnaire survey. Water quality and morphometric data for these systems were obtained from STORET, the national computer data base of the Environmental Protection Agency, and various reports. Two stepwise discriminate analyses were performed on normalized data; the variables area, maximum depth, and pH were found to be significantly related to walleye success in lakes. In addition, the variable date of dam closure was included in the reservoir data set. Using a jackknife discriminate analysis, 71% of the lakes and 72% of the reservoirs were classified correctly. Use of the model increases the probability of predicting the establishment of a self-sustaining walleye population by about 20%. (Author's abstract)
W91-00691

WATER QUALITY IN THE BARYCZ RIVER AND ITS TRIBUTARIES WITHIN THE AREA OF THE LOW SILESIAN COMMERCIAL FISHERY FARM IN MILICZ (JAKOSC WODY RZEKI BARYCZY I JEJ DOPLYWOW NA OBSAZARZE DOLNOSLASKIEGO KOMBINATU RYBACKIEGO).
Akademia Rolnicza, Wroclaw (Poland). Dept. of Limnology.
For primary bibliographic entry see Field 5B.
W91-00734

EFFECT OF REGULATION ON 0+ FISH RECRUITMENT IN THE GREAT OUSE, A LOWLAND RIVER.
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
For primary bibliographic entry see Field 6G.
W91-00777

FEEDING OF SILVER CARP IN EUTROPHIC LAKE PAPROTECKI IN THE MAZURIAN LAKE REGION: I. CHARACTERISTICS AND EVALUATION OF FEEDING CONDITIONS (ODZYWIANIE SIE TOLPYGI BIALEJ (HYPOPHTHALMICHTHYS MOLITRIX VAL.) W EUTROFICZNYM JEZIORZE PAPROTECKIM NA MAZURACH: I. CHARAKTERYSTYKA I OCENA WARUNKOW POKARMOWYCH).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
J. Leszczynska-Kowalska.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 1, p 7-16, 1990. 2 tab, 31 ref. English summary.

Descriptors: *Carp, *Eutrophic lakes, *Fish food, *Fish stocking, *Lake fisheries, *Limnology, *Poland, Biomass, Eutrophication, Fish behavior, Phytoplankton, Zooplankton.

The feeding conditions encountered by a population of silver carp introduced into a eutrophic lake were evaluated. Five qualitative and quantitative investigations on the phytoplankton and zooplankton composition were carried out during the 1976 growing season. The biomass of phytoplankton was high during the study period, reaching 14.3 to 34.1 mg/L. A quantitative and qualitative analysis of the phytoplankton composition, especially of the blue-green algae which (at high concentrations) can cause perturbations in fish feeding, showed that the algae were not too abundant and no danger of algal toxins was present. The biomass of zooplankton was also high (over 10 mg/L) and declined (to 1.7 mg/L) only towards the end of June, when fish feeding was intensive. The abundance and fractional size of the zooplankton was satisfactory throughout the growing season. Feeding conditions in the lake under study were favorable for the development of the introduced silver carp population. (See also W91-00784 and W91-00785) (Author's abstract)
W91-00783

FEEDING OF SILVER CARP IN EUTROPHIC LAKE PAPROTECKI IN THE MAZURIAN LAKE REGION: II. QUALITATIVE AND QUANTITATIVE ANALYSES OF NUTRITION AND NUTRITIONAL SELECTIVITY (ODZYWIANIE SIE TOLPYGI BIALEJ (HYPOPHTHALMICHTHYS MOLITRIX VAL.) W EUTROFICZNYM JEZIORZE PAPROTECKIM NA MAZURACH: II. JAKOSCIOWA I ILOSCIOWA ANALIZA POKARMU ORAZ WYBIORCZOSC POKARMOWA).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
J. Leszczynska-Kowalska.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 1, p 17-39, 1990. 3 fig, 6 tab, 50 ref. English summary.

Descriptors: *Carp, *Fish food, *Fish stocking, *Lake fisheries, *Limnology, *Poland, Cladocerans, Cyanophyta, Detritus, Eutrophic lakes, Eutrophication, Fish behavior, Lake Paprotecki, Nutrition, Phytoplankton, Population dynamics, Rotifers, Seasonal variation, Species composition, Zooplankton.

Qualitative and quantitative investigations were carried out on the feeding preferences of a silver carp population aged 3+ introduced into a eutrophic lake of known food conditions. Samples were taken five times during the algal growing season at periods coinciding with phytoplankton and zooplankton investigations. Silver carp feed mainly on detritus with phytoplankton and zooplankton making up the balance of the diet. The percentage of zooplankton in the diet was, at times, higher than of the phytoplankton. Feeding intensity was dependent upon thermal conditions and independent of food abundance. Analyses of feeding selectivity showed that silver carp fed on phytoplankton indiscriminantly, consuming all the blue-green algal species found in the lake, but distinct preferences were shown towards small zooplankton taxa. Rotifers and cladocerans were preferred over copepods. The feeding behavior of the silver carp population has a definite impact on the population dynamics and faunal composition of the lake. (See also W91-00785 and W91-00783) (Author's abstract)
W91-00784

FEEDING OF SILVER CARP IN EUTROPHIC LAKE PAPROTECKI IN THE MAZURIAN LAKE REGION: III. ATTEMPT TO EVALUATE THE PRESSURE ON PLANKTON OF THE INTRODUCED FISH POPULATION (ODZYWIANIE SIE TOLPYGI BIALEJ (HYPOPHTHALMICHTHYS MOLITRIX VAL.) W EUTROFICZNYM JEZIORZE PAPROTECKIM NA MAZURACH: III. PROBA OCENY PRESJI INTRODUKOWANEJ POPULACJI RYB NA PLANKTON).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
J. Leszczynska-Kowalska.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 1, p 41-54, 1990. 6 tab, 33 ref. English summary.

Descriptors: *Carp, *Fish food, *Fish stocking, *Lake fisheries, *Limnology, *Poland, Biomass, Ecosystems, Fish behavior, Lake Paprotecki, Phytoplankton, Population dynamics, Zooplankton.

An attempt was made to evaluate the impact of the silver carp population introduced into a eutrophic lake on the plankton biocenosis. On the basis of investigations on the plant and animal plankton an estimation was made of phytoplankton and zooplankton production in the lake, and on their consumption by the introduced fish population. Calculations were made of indices to show utilization of plankton biomass as food by the fish. Utilization of plankton biomass for fish consumption may reach a maximum of 5% for zooplankton and 1% for phytoplankton. Plankton biomass capable of being converted to usable energy by the fish was respectively lower: for zooplankton, around 0.6%; for phytoplankton, around 0.1%. The impact of the fish population on the plankton biocenosis was only slight, making it feasible to increase the level of fish stocking in the lake. Further investigations should be carried out at increased stocking with fish and for longer periods of time. (See also W91-00783 and W91-00784) (Author's abstract)
W91-00785

USE OF UV RADIATION FOR DISINFECTING WATER IN FIRST STAGE GROWTH TANKS STOCKED WITH RAINBOW TROUT LARVAE (ZASTOSOWANIE PROMIENIOWANIA UV DO DEZYNFEKCJI WODY W PODCHOWALNI WYLEGU PSTRAGA).
Instytut Rybactwa Srodladowego, Piaseczno (Poland). Zaklad Rybactwa Stawowego.
R. Kolman.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 102, No. 1, p 71-85, 1990. 6 fig, 3 tab, 15 ref. English summary.

Descriptors: *Disinfection, *Fish stocking, *Ultraviolet radiation, *Water treatment, Aquatic bacteria, Bacterial analysis, Fish diseases, Fisheries, Recirculated water, Water analysis.

A system was designed and constructed using pressure bactericidal lamps type TUV-30 for disinfecting water. The studies dealing with the effectiveness of this system consisted of the following: model studies, aimed at checking effectiveness of the system at various operation variances, and semitechnical studies, which yielded abundant material characterizing the effect of applied radiation doses at continuous operation on total bacterial counts. The system was found to be useful for treatment of water in recirculating systems used for the production of stocking material. (Author's abstract)
W91-00786

SPATIAL AND TEMPORAL VARIATION IN FISHES OF RIFFLE HABITATS: A COMPARISON OF ANALYTICAL APPROACHES FOR THE ROANOKE RIVER.
Oklahoma Univ., Kingston. Biological Station.
W. J. Matthews.
American Midland Naturalist AMNAAF, Vol. 124, No. 1, p 31-45, July 1990. 3 fig, 5 tab, 33 ref, append.

Descriptors: *Fish populations, *Riffles, *Roanoke River, *Virginia, Bottom sampling, Cluster analysis, Darters, Data acquisition, Fish behavior, Multivariate analysis, Sampling techniques, Seasonal variation, Spatial distribution, Statistical analysis, Temporal distribution.

Spatial and temporal variation in fishes in riffles of the upper Roanoke River system (Virginia) were analyzed in three ways: a two-way (space-time) analysis of variance (ANOVA) of species abundance; a comparison of spatially adjacent and temporally consecutive fish assemblages by Morisita's index of similarity; and comparison of all space x time samples by cluster analysis. At six sites on the river mainstream or large tributaries, fish in riffles were collected by kicknet sampling in five surveys from May to November 1978. For species with significant differences in abundance across space or time, variance components were combined into ratios that show relative importance of 'temporal,' 'fixed spatial' and 'ephemeral spatial' effects. The ANOVA was carried out on individual species, but Morisita's index and the cluster analysis were calculated for the entire assemblage of riffle fishes in each sample. Four of the nine most common species (three benthic darters and one sucker) exhibited significant spatial and/or temporal variance, with more of the variance accounted for by spatial than by temporal differences. For two of the four species, the spatial variance was primarily ephemeral, but for the other two spatial variance was

persistent (fixed). Results of the cluster analysis reinforced for whole assemblages the patterns detected for individual species, in that more within-site than within-time similarity existed. Comparison of adjacent and temporally consecutive sites by Morisita's index produced results differing somewhat from those of the first two analyses, in that spatial and temporal differences in assemblages appeared essentially equal. Each of the analytical approaches provided a somewhat different view of sources of spatial and temporal variation in riffle fishes of this stream system, but the overall conclusion was that spatial variation generally exceeded temporal variation. The results suggested that to adequately survey fish of riffles in this or similar systems it may be better to increase the total number of sampling sites, than to increase the number of collections per site. (Author's abstract)
W91-00868

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

PROFESSIONAL CERTIFICATION AND REGISTRATION FOR WATER-RESOURCES AND RELATED DISCIPLINES.
For primary bibliographic entry see Field 6E.
W91-00267

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information Center Services

NATIONAL WATER INFORMATION SYSTEM USER'S MANUAL VOLUME 2, CHAPTER 3. AUTOMATED DATA PROCESSING SYSTEM.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W91-00442

SOURCES OF WATER-USE INFORMATION IN MAINE.
Maine Geological Survey, Augusta. Dept. of Conservation.
For primary bibliographic entry see Field 6D.
W91-00443

10F. Preparation Of Reviews

FATE AND TRANSPORT OF PETROLEUM RELEASED FROM UNDERGROUND STORAGE TANKS.
University of Southern California, Los Angeles.
For primary bibliographic entry see Field 5B.
W91-00452

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Use of a Gel-Forming Biopolymer Directly Dispensed into a Loop Fluidized Bed Reactor to Recover Dissolved Copper.
W91-00813 5D

ACCELERATED EROSION
Dimensionless Analytical Solutions for Dam-Breach Erosion.
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Effect of Humic Substances on the Toxicity of Aluminum to Adult Rainbow Trout, Oncorhynchus mykiss (Walbaum).
W91-00371 5C

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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

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10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

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ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

1991 Price Schedules for the United States, Canada, and Mexico

These prices are for customers in the United States, Canada, and Mexico; other customers, write for price list PR-360-4.

Microfiche & Paper Copy Reports

Standard Prices

A01	$8.00
A02	11.00
A03	15.00
A04–A05	17.00
A06–A09	23.00
A10–A13	31.00
A14–A17	39.00
A18–A21	45.00
A22–A25	53.00
A99	*

"N" Codes

N01	$60.00
N02	59.00
N03	20.00

Exception Prices

E01	$10.00
E02	12.00
E03	14.00
E04	16.50
E05	18.50
E06	21.50
E07	24.00
E08	27.00
E09	29.50
E10	32.50
E11	35.00
E12	38.50
E13	41.00
E14	45.00
E15	48.50
E16	53.00
E17	57.50
E18	62.00
E19	69.00
E20	80.00
E99	*

Computer Products

Diskettes

D01	$50
D02	80
D03	130
D04	180
D05	230
D06	280
D07	330
D08	380
D09	430
D10	480
D11	530
D12	580
D13	630
D14	680
D15	730
D16	780
D17	830
D18	880
D19	930
D99	*

Magnetic Tapes

T01	$165
T02	220
T03	340
T04	450
T05	560
T06	670
T07	780
T08	890
T09	1,000
T10	1,110
T11	1,220
T12	1,330
T13	1,440
T14	1,550
T15	1,660
T16	1,770
T17	1,880
T18	1,990
T19	2,100
T99	*

* Contact NTIS for price

Prices effective January 1, 1991

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